THE MARINE REVIEW

VOL. 37. CLEVELAND, MAY 21, 1908. NEW YORK No. 21

MODERN ORE HANDLING MACHINERY.---I.

By Walter G. Stephan.[1]

Machinery designed to unload iron ore is attracting the attention of all who are interested in the manufacture of iron and steel at the present time because of its bearing upon the cost of both of these products. The cost of unloading from lake boats has been one of the important items which entered into the price of iron ore delivered at the furnace.

How great the percentage of reduction in the cost of unloading ore has been since the introduction of improved machinery is a matter of a very few words. About 20 years ago, it cost anywhere from 30 to 50 cents per ton to unload iron ore by the primitive method of shovels, wheelbarrows and tubs which were hoisted out of the hold of the vessel by means of a cable and horse.

The introduction of the first Brown unloading bridges, the pioneers in this field, reduced this cost to about 18 cents per ton while some modern plants installed within the last five years have brought this figure below 5 cents per ton. Inasmuch as it re-

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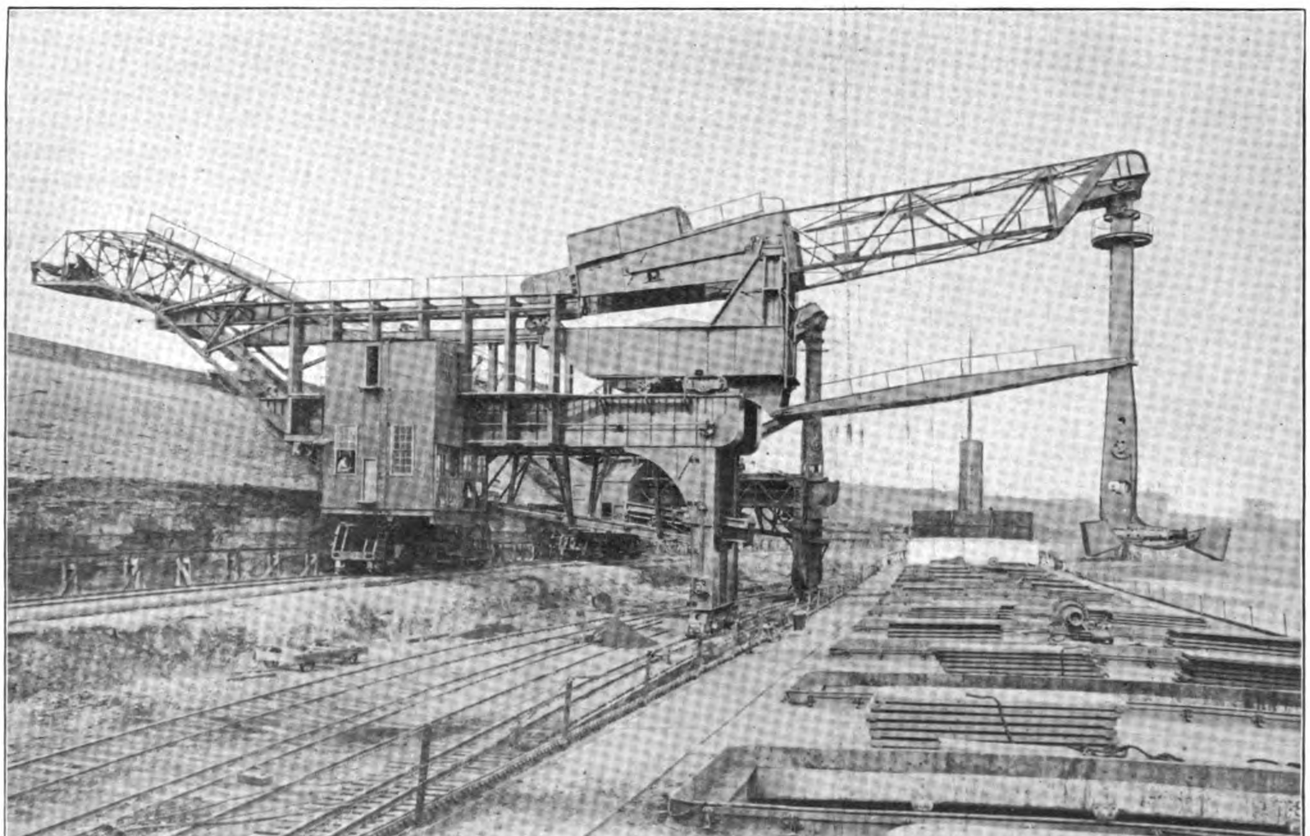


Fig. 1—Hulett Electric Ore Unloaders, National Tube Co., Lorain, O.

quires approximately two tons of iron ore to make one ton of iron, the effect of this reduced cost of unloading is a reduction in the cost of iron of from 50 cents to $1 per ton. In addition to this, it must be borne in mind that the improved unloading facilities permit the ore fleet to make many more trips per season than formerly, a factor which is certainly not to be considered unimportant.

Where formerly it took a week to unload a cargo, it now takes on an average from 5 to 10 hours. On account of the shortness of the season of navigation on the great lakes, and the great tonnage required to be delivered by the ore fleet in the seven open months, it is important that as little time as possible be consumed in the actual work of unloading. Unwarranted delay at the dock, because of repairs to the unloading plant, is a source of great moral upheaval on the part of the otherwise genial lake captain.

Again the saving of only one cent at some of our modern docks where from 1,000,000 to 4,000,000 tons of ore are unloaded in one season amounts to from $10,000 to $40,000 per season.

The Hulett Electric Ore Unloader.

In Fig. 1 is illustrated one of the two new electric ore unloaders which were installed at the docks of the National Tube Co., Lorain, O., in the spring of 1907. These unloaders are larger than the old machines (one of which is shown in the background) but are built along the same general lines.

There are several features about these docks which offered complications materially affecting the design of this plant. First, the dock itself is located on a concave bend in the river of about 1,200 foot radius. Second, the tube company's plant is located on the level of the top of a high bank—making it necessary for the unloaders to lift the ore about 60 feet in unloading. The greater part of the bench on which the machines rest was cut from the natural bank, cribbing being built out to support the railroad tracks and the front legs of the unloaders.

The bucket is attached to the foot of a built-up steel leg and has a capacity of 10 tons. This bucket leg is held in a swivel supported by trunnions at the water end of a huge walking beam. It is held in a vertical position throughout its entire path by means of a parallel arm pivoted below on the trolley and fastened to trunnions in a swivel ring on the leg. By means of cables and sheaves located at the top, the leg can be rotated through an arc of 320 degrees so as to allow the bucket to work at any angle in the hatch of a boat. The bucket is operated by a man located in and traveling with the lower end of the leg. It has not only the movements of opening and closing its jaws but one scoop can be telescoped so as to reach out a distance of 15 feet 4 inches from the center line of rotation of the leg—this movement allowing it to cover more than half the distance between the hatches of any boat and thus unload 90 per cent of the cargo of an ordinary ore boat, and in the case of some modern boats, fully 97 per cent.

The bucket is operated directly by flat link chains which are wound up on drums in the leg, these drums being driven through spur gearing by means of two steel cables, one for opening and one for closing, which lead up through the center of the leg and the front end of the walking beam to a drum just behind the pivot pin.

The walking beam is pivoted at the center, the pivot pin being supported in two bearings resting on the uprights of the trolley frame. It is balanced by means of the machinery and cast iron counterweights at the rear end, so as not to allow more than just enough pressure on the bucket scoops to dig 10 tons of ore.

The hoist for raising and lowering the beam is located at its extreme rear end and consists of two drums driven through spur gearing by a 150 horsepower Westinghouse mill type motor. Two cables lead from each drum over double grooved sheaves anchored at either side of the rear end of the trolley frame, the return cables being anchored to the rear of the walking beam.

The trolley is carried on two heavy equalized front trucks which travel back and forth on the main girders of the machine, at right angles to the dock. This movement is accomplished by means of two pinions and racks, one on each girder—the pinions being driven through spur gearing by a 75 horsepower Westinghouse railway motor.

On account of the forward position of the walking beam pivot with respect to the front trucks, the rear of the trolley is provided with two inverted equalized trucks which travel on an inverted track supported from the girders below. Automatic stops and electric cutouts are provided so as to prevent accidents from over travel in either direction—these being entirely independent of the operator. All the movements of the trolley, walking beam and bucket leg are controlled by the operator in the leg through master controllers. The oscillating motion of the walking beam is provided with automatic cut outs and a mechanical safety latch which will hold the beam in case of extreme over travel. These safety latches are very similar to the ordinary door latch. All of the operating machinery is provided with solenoid brakes which set as soon as the current is cut out.

The main girders rest upon heavy yokes at the front and rear, and span two standard gage tracks underneath. The rear yoke rests on two nests of rollers which run on curved tracks fastened to the rear truck girder underneath. The tracks are curved so that the entire machine may be swung about a pivot on the center line between the front trucks. This swinging is necessary on account of the curvature of the dock. When the large ore boats are tied up for unloading the side of the boat amidships is about 12 feet from the dock. So in order to "square the machines to the hatches" it is necessary to provide for a swinging motion of the entire machine. This is accomplished by means of several steel cables which are anchored to either end of the rear yoke and which are wound on and off a drum on the rear truck girder, driven through a worm and worm wheel by a 50 horsepower motor. The rear truck girder is of heavy construction and is ingeniously designed to equalize the unusually heavy loads on the rear trucks. There are 24 wheels under this girder traveling on two curved tracks. These wheels are ground to different diameters to allow for the curvature of the dock and eight of them are driven through spur and bevel gearing from the machinery house above. This drive is accomplished by the use of a square pinion shaft running between the driving trucks on which slides a spur gear held in a frame under the house which can adjust itself to the varying positions of the shaft due to the swinging of the machine. A second gear is held in mesh with the first in the frame and it is driven through universal couplings and bevel gears from the machinery house above.

The front yoke of the unloader rests upon two conical rollers one on each side mounted in bearings on the center of the truck beam. Each truck has eight wheels—all equalized and four of them driven through bevel gears from the machinery house as

shown in the cut. The drive is accomplished through the pivot casting on the center line of the front yoke, which also forms the pivot about which the machine swings.

Two rails riveted to I-beam stringers between the main girders form the track for the bucket car, which is a large double hopper car holding somewhat more ore than the grab bucket can dig. The track is bent to a reverse curve extending from the face of the machine to the end of the cantilever which projects out on the land side to support it. The object of the bucket car is to shorten the travel of the bucket in and out of the hold so as to save time. The bucket dumps its load into the car and while it is returning for another, the car is hoisted to the top of the incline and dumped—returning in time to receive the next load. A complete cycle can easily be made in less than one minute. This car can be dumped automatically either at the top of the cantilever into the concrete trough below or into railroad cars on either track at the dock level. The bucket car is hoisted by cables running up the incline and back to the drum in the machinery house, and returns by gravity. A novel safety device has been provided for the bucket car, in case the cables should break, in the shape of two cast steel racks, one on each side of the track rails. Large cast steel pawls are fastened to the side of the car, which engage the teeth of the racks when the car ascends loaded, and which are automatically raised from them when the doors of the car are opened and the load is dumped for the return trip. This safety device has been tested on several occasions and has never failed to operate successfully.

The car haulage drum is located in the machinery house and is geared to a 200 horsepower specially designed Westinghouse mill type motor—the largest motor of its kind and type ever built. The ore is rehandled from the concrete trough at the top of the bank to the stock pile or furnace by a Hoover & Mason bridge operating a 15-ton grab-bucket. The bottom of the trough is lined with steel rails upon which the bucket shells dip.

The speed of travel of the Hulett unloader along the dock is over 75 feet per minute and its total weight is about 850 tons. The bucket has a capacity of 10 tons and a maximum spread of 19 feet 6 inches when telescoped. Its maximum reach is 65 feet from the face of the dock, which provides for larger boats than are now built.

Current is supplied to the four unloaders at this plant by two T-rails conductors running parallel with the tracks behind the rear girders. Cast iron shoes bearing upon the heads of the rails take off the current, from which point it is wired to the various motors and controllers. A similar system of rail conductors and shoes carries current to the trolley from the main girders. All the castings on the unloaders are of steel excepting the counterweights and a few small details.

One of these machines will average 500 tons per hour in unloading the first half of a cargo and the record for the four machines at this dock—two new and two old—is over 532,000 gross tons in one month.

On Oct. 23, 1907, these four machines unloaded 10,092 gross tons of ore from the steamer J. C. Wallace in 6 hours and 24 minutes, working 22 men in the hold for about one-quarter of the time. This is an average of 394 tons per hour, which is said to be the best record made on the great lakes for speed.

To operate one of these unloaders requires an operator in the bucket leg, an operator in the machinery house to handle the car and move the machine, an oiler and about five men in the hold for one quarter of the working time, to clean up.

A Hulett Ore Handling Bridge.

The immense stock of ore which has to be stored on the docks for furnace plants in order to supply the furnaces with material during the winter months, has brought about the design of huge ore bridges which span the stock piles and which operate an automatic self-filling bucket used for storing the ore and also for reclaiming it when it is wanted for immediate use.

An excellent example of the modern ore bridge is shown in Fig. 2. This was installed at the docks of the Wheeling & Lake Erie railroad, at Huron, O., in 1907. It is used in conjunction with the four direct unloaders which were built some time previous by the Wellman-Seaver-Morgan Co. The main span of the bridge is 285 feet with an 85-foot cantilever on the tower end and a 45-foot cantilever on the shear leg end—making a total of 415 feet over all. The maximum travel of the bucket is 397 feet. The bucket is a 10-ton Hulett excavating bucket opening at right angles to the length of the bridge, and it is handled from a simple four-sheave trolley running on tracks suspended below the floor beams of the bridge in the usual manner. The bridge proper is made up of two riveted Pratt trusses 14 feet centers, supported on a pivot at the tower and hung from the shear leg on eye bars. The shear leg is laid out in very graceful lines and offers an unusually large open space for bucket clearance—an item which is a very important consideration. It rests on two four-wheel trucks 50 feet apart with ball and socket joints—both trucks being driven by means of gearing and shafting which extends up both sides of the leg and connects with a cross shaft on the bridge, through universal couplings. From this cross shaft a driving shaft extends along the far side of the bridge to the tower and thence down in the same manner to the machinery house below. The flexible shaft connections are provided so as to allow for the skewing of the entire machine in case of misalignment or in case it is desired in the regular operation of the bridge.

The tower supports the bridge on a heavy cross girder which in turn is supported on A-frames extending to the trucks below. The machinery house is placed to one side of the supporting frames and is large enough to cover the hoist engine, trolley engine, boiler and fuel supply. The entire tower is supported on six four-wheel trucks, two of them idlers and four of them driven from the main hoist engine. These trucks are provided with ball and socket joints or with expansion bearings to allow for a variation in the gage of the tower tracks which are 32 feet center to center. The tower spans two standard gage railroad tracks for cars, which are loaded through hoppers supported in the tower frame above. A noteworthy feature of this tower is the liberal clearance allowed for the bucket—it offers no obstructions which must be carefully avoided by the operator and which would cut down the speed of operation. The operator is located in a house high up on the tower frame, a position which gives him a clear view of all the movements of bucket and bridge, even when the stock pile is at its maximum height. His eyes are in a plane a few feet below the level of the trolley track stringers.

The operating mechanism in the house was purposely designed to be operated by either one or two men as desired. Long double tension wires connect the operator's levers with the operating shafts below.

The machinery house covers the main hoist engine which is a 16 x 20-inch double drum geared hoist, the trolley engine, which is an 11 x 15-inch direct-connected hoist, and a 200-horsepower modified type of marine boiler. A coal bunker inside is provided with a separate drum hoist and derrick for raising coal in tubs from cars underneath.

The speed of travel of the bridge along the dock is about 75 feet per minute—the trolley speed is 1,000 feet per minute, and the hoisting speed, 225 feet per minute.

The bucket will handle 12 tons of some kinds of ore, and the maximum capacity of the bridge is 500 tons per hour. All the castings on the bridge are of steel, annealed so as to reduce internal strains to a minimum.

The ore stock pile underneath the bridge has a capacity of 700 gross tons per lineal foot. The entire bridge is operated by two men—one operator in the operator's house and one engineer and fireman in the machinery house.

Hulett Movable Ore Car Dumper.

The idea of a machine built to dump an entire car load of ore at once is not a new one today, but the idea of a car dumper which is itself movable and which will perform this unloading feat anywhere along its track is quite new. The illustration, Fig. 3, shows the second movable car dumper which has ever been built, the first one being in successful operation at the works of the Cambria Steel Co. It was designed by the Wellman-Seaver-Morgan Co. and installed at the National Tube Co.'s plant at McKeesport, Pa. It has a capacity of 175 cars per day and is built to handle railroad cars of 150,000 pounds capacity; that is, larger than any cars now built, as well as the smallest cars now in use.

The reason for building a movable car dumper is to do away with one handling of the ore. It has been the practice in the past, in similar cases, to dump the car into small transfer cars which were hauled to the ore bridge and thence over the stock pile to be dumped. With the movable dumper the ore is dumped into a V-shaped trough of concrete, at any point along its length, and from there the bucket, swung from an ore bridge, reclaims it and stores it in the stock yard.

The car dumper shown dumps the ore over a 10-foot wall into a concrete trough. The dumper consists of a rigid rectangular steel frame mounted on four front and two rear trucks. All of the trucks have four wheels and are provided with ball and socket joints. Two expansion bearings are provided on the rear trucks to provide for any change in the gage of the tracks. A feature in connection with the design of this machine is the fact that it is used on a grade of 1¼ per cent, which makes it necessary to use fillers of varying width under the trucks. Two of the front trucks are driven and two are idlers. Both rear trucks are driven. Four corner posts are supported on the front and rear truck girders, which extend to, and support, the machinery floor at the top. These posts are braced in three planes only. A heavy built-up cradle of L-shape is pivoted on two 9-inch pins anchored half way up on the center line of the front posts, and it is rotated about these pivot pins as centers by means of eight heavy cables which wind about it like an irregular shaped drum and are finally fastened to a pair of drums located on either side of the machinery house on top. On the floor of the cradle is a platform called a platen which carries the rails for the cars and which is automatically moved sideways on rollers so as to rest the sides of the car against the cradle in dumping. This movement is necessary because the car dumper must be made to handle cars of any width or height. Four automatic clamp beams are provided which are operated by a series of

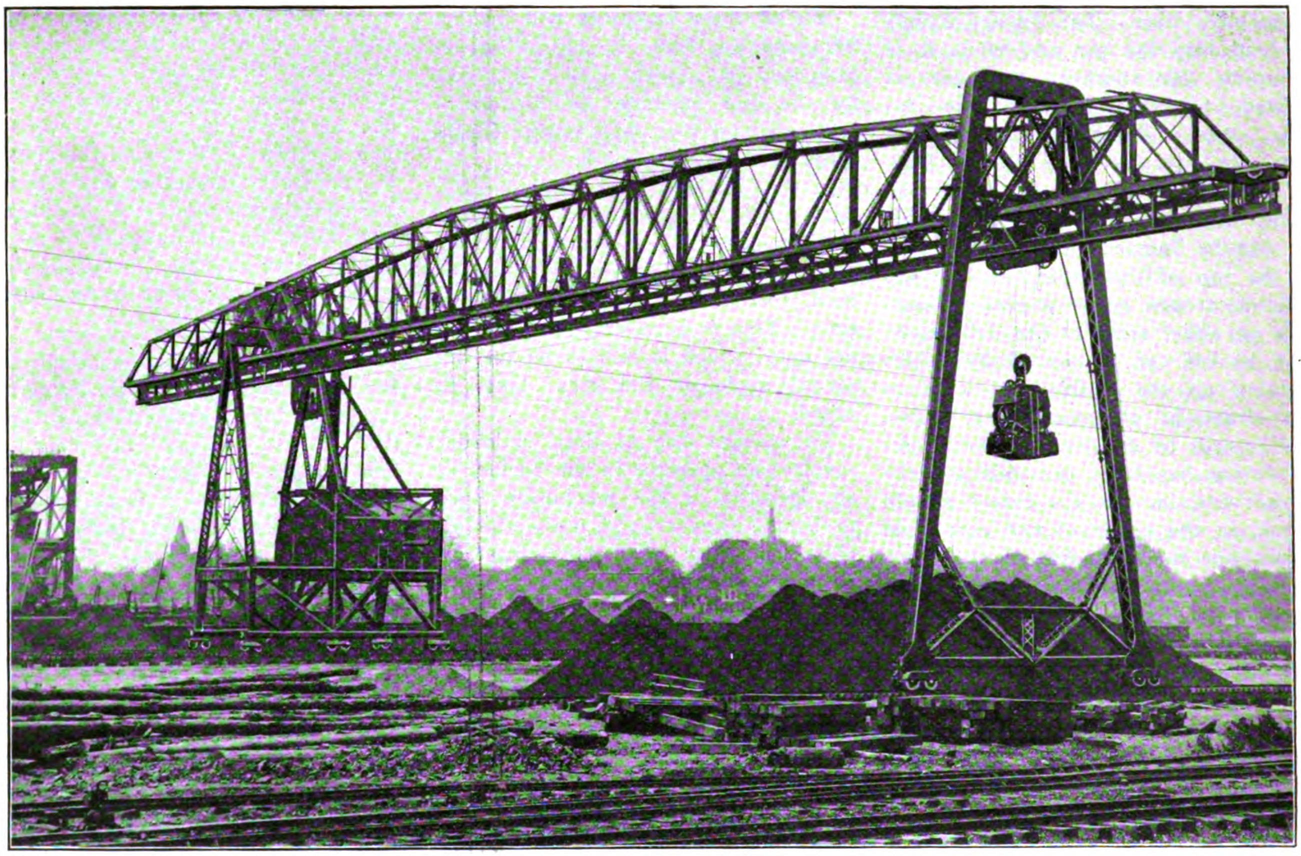


Fig. 2—Hulett Ore Unloading Bridge, Wheeling & Lake Erie Railroad, Huron, O.

counterweights at the rear, and by a cam motion anchored to the front truck girder. After the car is run on to the platen the hoisting drums above are rotated and the hoist cables are wound in, thus turning over the cradle and car. As this turning progresses the platen is first automatically moved over by springs until the car body is against the side of the cradle and then the four clamp beams gradually descend until they rest upon the top of the car, holding it firmly in place while dumping. On the return movement of the cradle the clamps are automatically raised off the car, so that no attention need be paid to clamping the car after it is on the cradle. Two independent sets of counterweights are provided which are designed to help the cradle hoist in lifting the car in its first motion and also to help to hold the cradle and car when they are turned over. The cradle is designed to handle cars up to 50 feet in length and from 5 feet 9 inches to 12 feet 6 inches in height.

The approach track to the car dumper is on an incline and is made of steel castings which are so designed that they line up with the standard gage track for the cars. They are so made that there is very little jar when the car wheel enters the incline, the incline castings being so made that the load is first taken by the flange of the wheel and then gradually delivered to the tread as the car rides up the slope. The speed of travel of the entire dumper along the tracks is 100 feet per minute.

The machinery house above contains the cradle hoist and the moving motor and shafting. The cradle hoist consists of two drums geared through spur gearing to two 150-horsepower mill type Crocker-Wheeler motors in series. The moving motor is a 75-horsepower Crocker-Wheeler motor and drives all four driving trucks through one line of shafting running the entire length of the machinery floor.

FIG. 3—HULETT MOVABLE CAR DUMPER, NATIONAL TUBE CO., MCKEESPORT, PA.

The operator's house is located on the front post on the far side of the machine. He stands facing the car dumper and the approaching car. All of the movements of the machine are under his control. The controllers are of the magnetic switch type with master controllers in the operator's house similar to those in the ordinary elevator. If he wishes, the operator can sit down while handling his levers. Solenoid brakes are provided for all the movements and a special emergency foot brake lever is within easy reach. The lowering is done by reversing switches in the controller, which make the motors act as generators and retarders, thus giving perfect control without the use of mechanical devices. Electric cut-outs are installed which are independent of the operator and which prevent over travel of the cradle in either direction.

The total weight of the car dumper is 780,000 pounds. Except for a few minor castings, counterweights, etc., everything is steel. Fire-proof construction is used throughout. The machine has been so successful in operation that another one is being built at Youngstown for the Youngstown Sheet & Tube Co.

CERTIFIED WHEEL CHAINS.

Under the title of "Safeguarding a Floating Fortune," the James McKay Co., of Pittsburg, Pa., gives an interesting talk on marine chains. There is probably no subject of greater interest to vessel owners than that of chains. All one has to do to discover the importance of the subject is to examine the list of accidents on the lakes, so many of them being due to the parting of wheel chains. Every chain that the James McKay Co. puts out is accompanied by certificates of test. They can be depended upon to stand a much greater strain than will ever be imposed upon them in actual use. Their certified wheel chains have been made and sold by them in large quantities for the past 28 years, and all that time the company never received a report of breakage resulting in serious accident or in expensive delay. The company uses only the highest quality of double refined charcoal iron and even then it is not worked into chains until it has undergone certain physical and chemical tests. The high cost of double refined charcoal iron naturally makes the first cost of certified wheel chains higher than others, but first cost is of slight moment when one considers the responsible part that wheel and steering gear chains play in navigation. It is poor economy to save on the wheel chain. The H. D. Cushman Co., 1014 Citizens building, are the Cleveland agents of the James McKay Co., from whom copies of this interesting booklet may be secured.

The city of Chester will present the scout cruiser Chester with a handsome silver service on June 10.

SUMMARY OF NAVAL CONSTRUCTION.

Since the last summary of naval construction was issued by the bureau of construction and repair of the navy department the battleships North Carolina and the scout cruisers Chester and Birmingham have been delivered to the government. Following is the summary:

Name of Vessel.	Building at—	—1908— Per cent of completion. Apr. 1.	May 1.
	BATTLESHIPS.		
South Carolina	Wm. Cramp & Sons	42.20	45.90
Michigan	New York S. B. Co.	48.60	50.70
Delaware	Newport News S. B. Co.	18.10	22.80
North Dakota	Fore River S. B. Co.	25.70	31.60
	ARMORED CRUISERS.		
North Carolina	Newport News S. B. Co.	99.00	100.*
Montana	Newport News S. B. Co.	97.00	98.00
	SCOUT CRUISERS.		
Chester	Bath Iron Works	99.10	100.**
Birmingham	Fore River S. B. Co.	99.10	100.***
Salem	Fore River S. B. Co.	95.20	96.40
	TORPEDO BOAT DESTROYERS.		
T. B. Destroyer No. 17	Wm. Cramp & Sons	12.00	15.90
T. B. Destroyer No. 18	Wm. Cramp & Sons	10.80	15.40
T. B. Destroyer No. 19	New York S. B. Co.	11.50	16.20
T. B. Destroyer No. 20	Bath Iron Works	8.00	9.70
T. B. Destroyer No. 21	Bath Iron Works	7.80	9.30
	SUBMARINE TORPEDO BOATS.		
Submarine T. B. No. 9	Fore River S. B. Co.	99.00	99.00
Submarine T. B. No. 13	Fore River S. B. Co.	30.00	40.50
Submarine T. B. No. 14	Fore River S. B. Co.	30.00	39.90
Submarine T. B. No. 15	Fore River S. B. Co.	30.10	34.00
Submarine T. B. No. 16	Fore River S. B. Co.	29.90	34.20
Submarine T. B. No. 17	Fore River S. B. Co.	10.30	13.60
Submarine T. B. No. 18	Fore River S. B. Co.	10.30	13.40
Submarine T. B. No. 19	Fore River S. B. Co.	10.30	13.00
	COLLIERS.		
Vestal	Navy Yard, New York	76.40	80.60
Prometheus	Navy Yard, Mare Island	44.40	52.30
	TUG BOATS.		
Patapsco	Navy Yard, Portsmouth	55.00	63.00
Patuxent	Navy Yard, Norfolk	55.30	60.20

* Delivered to government, at Norfolk Navy Yard, April 27, 1908.
** Delivered to government, at Portsmouth Navy Yard, April 24, 1908.
*** Delivered to government, at Boston Navy Yard, April 10, 1908.

OBITUARY.

Rear Admiral Charles W. Rae, engineer-in-chief of the bureau of steam engineering of the navy department, died at his home in Washington last week from a complication of diseases. He was a man of many admirable parts and his death is greatly regretted by the navy department.

Rear Admiral Rae was born in Hartford, Conn., June 30, 1847, and was graduated with the degree of civil engineer from the Rensselaer Polytechnic Institute at Troy in July, 1866. He was appointed to the naval academy from this state in October of that year, and on graduating on June 2, 1868, was made a third assistant engineer. After leaving Annapolis he was assigned to the Conoocook, afterwards called the Albany, the flagship of the North Atlantic fleet. He was promoted to second assistant engineer in June, 1869, and served as assistant to the inspector of machinery afloat from September, 1869, until April, 1870.

Rear Admiral Rae served with the Tehuantepec and Nicaragua canal surveying expedition in 1870 and 1871. He had also served on the Terror, Wabash, Juniata, Plymouth, Alert, Mayflower, Pensacola, Wachusett, Powhattan, Lancaster, Trenton and Atlanta. He became an assistant engineer in 1874, passed assistant engineer in 1875, and chief engineer in 1893. He was on duty at the naval academy from January, 1874, until June 1, 1878; was in the bureau of steam engineering in Washington from June, 1881, until June, 1884, and later was a member of various boards.

Six years after being commissioned chief engineer his rank was changed to that of commander. He was assigned to the battleship Iowa in June, 1897, as chief engineer, Capt. W. T. Sampson being the commander of the vessel. He served on the Iowa throughout the war with Spain, having been engaged in the bombardment of San Juan, Porto Rico, as well as in the numerous bombardments at Santiago, Cuba. He was advanced three numbers in grade for eminent and conspicuous conduct in battle, and received a medal for the campaign in the West Indies. He was assigned to the training station in San Francisco in March, 1899, and a year later was appointed a member of the naval examining board and technical examiner for the United States civil service commission.

When Rear Admiral Melville was retired for age in 1903, Capt. Rae was appointed chief of the bureau of steam engineering with the rank of rear admiral. Rear Admiral Rae was the first graduate of the naval academy to hold the position. In his term of office there have been such events as the development of oil as a fuel for naval vessels and the introduction of the turbine in place of the reciprocating engine. He had been a member of the Roosevelt board on naval personnel,

REAR ADMIRAL CHARLES W. RAE.

whose recommendations resulted in the legislation which, among other things, amalgamated the old engineer corps with the line. By reason of his readiness and promptness in recognizing the work of subordinates he commanded the respect and esteem of every man doing engineering duty in the navy. He was the second on the list of captains.

The Canadian government ice breaker Montcalm, which was built in Scotland, collided with the Canadian Pacific Railway Co.'s steamer Milwaukee and was beached at Hackett's Harbor, St. Lawrence river, being almost submerged. It is understood that the Montcalm attempted to cross the bows of the Milwaukee.

A red lantern light was established to mark the wreck of the schooner R. H. Becker, which obstructs the entrance into Sheboygan harbor. Boats are cautioned to keep close to the north pier.

Isham Randolph, consulting engineer, has moved his office to Suite 748, First National Bank building, Chicago.

NEW LIVERPOOL DOCKS.

At the weekly meeting of the Mersey docks and harbor board, the works committee brought forward their scheme of new docks at the north end of the dock estate authorized by act of parliament two years ago. This scheme embraces the undernoted new works which are estimated to cost £3,204,400.

A vestibule or half-tide dock, with a river lock entrance 870 ft. in length and 130 ft. in width, and having a sill 30 ft. below old dock sill, the foreshore in front of the said entrance being lowered to suit the sill level, and the river wall being underpinned and faced. Estimated cost, £1,378,800.

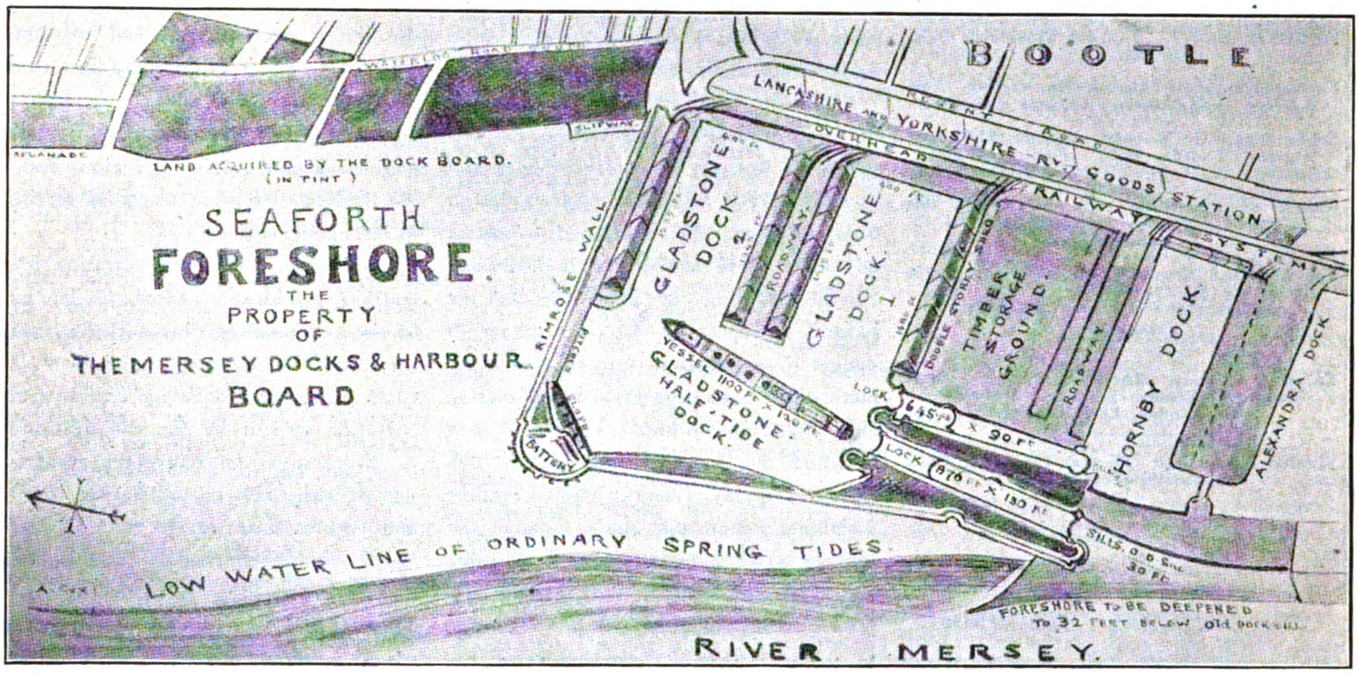
A lock, 645 ft. in length and 90 ft. in width, and having sills 20 ft. 6 in. below old dock sill, between the Hornby dock and the new half-tide dock referred to. Estimated cost, £204,600.

A branch dock (A1) opening out of the half-tide dock, and immediately to the north of the present timber storage ground, and having on the north side a double story shed, 1 295 ft. in length and 100 ft. in width, and on the south side a similar shed, 1,465 ft. in length and 150 ft. in width, with the necessary paving, railway sidings, etc., £881,000.

A branch dock (A2), also opening out of the half-tide dock to the north of the branch dock (A1), and having on the north side thereof a double story shed 1,265 ft. in length and 100 ft. in width, and on the south side a similar shed, 1,295 ft. in length and 100 ft. in width, with the necessary paving, railway sidings, etc, £740,000. The alteration of the timber storage ground north of the Hornby dock as may be necessary to make the same accord with the scheme of new docks, etc., above referred to at an additional cost of £11,427.

The necessity for this elaborate scheme of new docks and river entrances was clearly shown by J. W. Hughes, the chairman of the works committee, and other members. During the last three years, and since this project was first mooted, the tonnage of ships paying dock dues has increased by 600,000 tons. Furthermore, the record of ships paying dock dues on tonnage in Liverpool in the last 30 years is also an interesting one. In 1877, there were paid tonnage dues on 6,400,000 tons net register; in 1887 that had grown to 7,600,000 tons, an increase of 18 per cent; in 1897 it further advanced to 9,500,000 tons; while last year it rose to 13,500,000 tons, showing the huge increase of 42 per cent in the last decade. It is also a remarkable circumstance that in the 20 years from 1889 to 1907, the tonnage of the port has nearly doubled in spite of the fact that the port has had competition, friendly and otherwise, from new ports both at home and abroad. Mr. Hughes also went on to show that the magnitude of these proposed new docks was due mainly to the increasing size and depth of ships. In 1887 the largest ships using the port were 560 ft. long, in 1897 the ships had grown to 625 ft., and last year the largest ship was 760 ft. It was therefore proposed to make the entrance lock 40 ft. below the old dock sill, and the aim generally was to have a depth of 40 ft. on the lowest neap tide. The No. 1 branch dock would be 13 acres in area. Its quays on one side would be 1,480 ft. in length, and on the other side 1,215 ft. There would be double-story sheds with an area of 77,610 yards. No. 2 branch dock would have an area of 12¼ acres; the quay on one side would be 1,265 ft., and on the other 1,235 ft., and the shed space would be 56,888 yards. In the vestibule dock, leading to these branch docks, it would be possible to maneuver a vessel 1,100 ft. long into either of the new docks. This new system of docks will bear the name of Gladstone as a compliment to the present chairman of the dock board, and his family, who have been connected with Liverpool's shipping for over 100 years.

It was shown by other speakers that the accommodation for ships of the largest class at Liverpool was by no means superabundant, and that looking at the time it would take to build these new docks, it was a matter of urgent necessity that the board should push forward this work.



GENERAL PLAN OF NEW DOCKS PROPOSED FOR LIVERPOOL.

THE MARINE REVIEW

DEVOTED TO EVERYTHING AND EVERY INTEREST CONNECTED OR ASSOCIATED WITH MARINE MATTERS ON THE FACE OF THE EARTH.

Published every Thursday by

The Penton Publishing Co.

CLEVELAND.

BOSTON................1053 Exchange Bldg.
BUFFALO ....932 Ellicott Sq.
CHICAGO.............1328 Monadnock Blk.
CINCINNATI ....First National Bank Bldg.
NEW YORK ....1005 West Street Bldg.
PITTSBURG.................510 Park Bldg.
DULUTH ....411 Providence Bldg.

Correspondence on Marine Engineering, Ship Building and Shipping Subjects Solicited.

Subscription, U. S. and Mexico, $3.00 per annum. Canada, $4.00. Foreign, $4.50. Subscribers can have addresses changed at will.

Change of advertising copy must reach this office on Thursday preceding date of publication.

The Cleveland News Co. will supply the trade with the MARINE REVIEW through the regular channels of the American News Co.

European Agents, The International News Company, Breams Building, Chancery Lane, London, E. C., England.

Entered at the Post Office at Cleveland, Ohio, as Second Class Matter.

May 21, 1908.

OUR NATURAL RESOURCES.

The conference held at the White House last week to conserve the country's natural resources will probably be regarded as one of the most far-reaching movements projected by Theodore Roosevelt during his strenuous incumbency of the presidential office. Conserning our natural resources means a great deal. The tendency to exploit them without regard to future needs has been general, many men making fabulous fortunes by beggaring posterity. Wasteful and extravagant methods have been employed, frequently amounting to 50 per cent of the material put into actual use. So rapid has been the destruction that certain of our raw resources are in fair way of becoming extinct. Extremely prodigal has been the exploitation of the timber resources of the country, so much so that states that were once covered with pine have literally not a stick standing. Such treatment of a native resource is criminal, for with judicious management the timber resources of the country can be made to replenish themselves. It must be done, however, before complete denudation takes place, otherwise the rains necessary to the existence of vegetation will rush off in torrents to the sea instead of seeping gradually through the gentle processes of nature into the streams.

To this conference President Roosevelt invited the governors of the states, the members of the Inland Waterways Commission, certain members of both houses of congress and four representative citizens chosen at large. These four were Wm. J. Bryan, Andrew Carnegie, James J. Hill and John Mitchell.

President Roosevelt spoke for 55 minutes with tremendous earnestness, exhibiting great breadth of comprehension and much practical wisdom. Rarely has a man in public office appeared to better advantage. He stated that the occasion for the conference lay in the fact that the natural resources of the country are in danger of exhaustion if the old wasteful methods of exploiting them are permitted any longer to continue. The rapid pace at which the country is traveling is well exhibited in this remark. It is certainly a striking commentary that a country embracing a whole continent and touching upon two oceans should find its once supposedly inexhaustible natural resources in danger of exhaustion before it has barely more than completed its first hundred years of national life. The United States has grown great as a nation through the lavish use of its resources, but the time has come to call a halt and to inquire what will happen when the forests are gone and coal, iron, oil and gas are exhausted; when the soils are impoverished and the fields denuded.

The raw resources of the country are divided into two sharply distinguished classes according as they are or are not capable of renewal. The minerals cannot renew themselves, and, therefore, in dealing with coal, oil, gas, iron and the other metals generally conservation must come through wise administration of them. Eventual exhaustion cannot be avoided, but it may be delayed. The second class of resources consists of those which cannot only be used in such manner as to leave them undiminished for future generations, but which can actually be improved by use. The soil, the forest, the waterways, come within this category. In dealing with the soil and its products, man can improve upon nature by compelling the resources to renew and even reconstruct themselves in such manner as to derive increasingly beneficial uses, while the living waters can be so controlled as to multiply their benefits.

The president believes a timber famine to be imminent. He held it to be unpardonable for the nation or the states to permit any further cutting of timber save in accordance with a system which will provide that the next generations will see the timber increased instead of diminished. Moreover, we can add enormous tracts of the best possible agricultural land to the national domain by irrigation in the arid and semi-arid regions and by the drainage of great tracts of territory in the humid regions.

In discussing the transportation problem the president repeated the language of the announcement in which he created the Inland Waterways Commission. The country can enormously increase its transportation system by the canalization of its rivers so as to complete a great system of waterways on the Pacific, Atlantic and Gulf coasts, and in the Mississippi valley, from the prairies to the Alleghenies and from the great lakes to the Mississippi. These various uses of our natural resources should, however, be co-ordinated and treated as parts of one coherent plan and not in haphazard and piece-meal fashion.

Strikingly important addresses were made by Andrew Carnegie and James J. Hill. Naturally the most interesting portion of Mr. Carnegie's address would be that devoted to iron. He directed attention to the enormous expansion in the uses of iron that have occurred of late years and frankly felt that the deposits of raw material were not equal to maintain it. He thought that means should be employed to relieve iron of many of the uses to which it is now subject, otherwise the known deposits will be exhausted within half a century. He believed that such relief would come and pointed to the share of the work now performed by concrete that was formerly borne by iron.

James J. Hill paid great attention in

his address to the soil, which he felt was being impoverished from two grave sources, the first erosion, that is the washing away by streams; the second, by single cropping, that is, the planting of the same cereal year after year instead of allowing the ground to rest and be refreshed by a rotation of crops.

Elsewhere in this issue will be found the address of President Roosevelt and Mr. Carnegie. Both are worth studying, and, if the conference forms a nucleus for the conservation of our natural resources, the president will certainly have accomplished a great deal for the benefit of this country.

LAKE SITUATION.

While vessel owners have agreed not to open navigation until June 1 the actual opening is likely to be at a much later date, probably June 15 and possibly July 1. There is, in the expressive language of the street, "nothing doing." No condition, similar to the present one has ever confronted the trade. In former times of depression there have been periods of temporary stimulus, but the present state exhibits unvarying flatness. Leading shippers have not sold a pound of ore. This condition is so unusual that mine superintendents do not understand it and repeatedly asked when they may begin shipping ore to the receiving docks. The invariable reply is that as no ore has been sold it is not necessary to move it from the mines.

Estimates have again been revised and the maximum movement for 1908 is now placed at 20,000,000 tons. This could be safely moved if the fleet did not leave port until July 1, though it could be more comfortably done if the general movement was made on June 15. It is probable that notwithstanding the complete prostration of industry the movement of ore will not be permitted to fall below 20,000,000 tons, as the great steel-making companies doubtless desire to protect their reserves. Ore on dock and in furnace piles probably aggregated 19,000,000 tons on May 1. It is the part of wisdom to maintain an ample margin over actual necessities at all times. The present depression cannot last very long, and an ample reserve pile may be one of the necessities next spring. The revival of business will come as soon as the conviction becomes general that the bottom has been reached.

At present there are certainly strange sights to be seen along the lakes. Every harbor is congested with vessels. Seven of the great steamers of the Cleveland-Cliffs Iron Co. are lying in ordinary in the slips of the Great Lakes Engineering Works at Ecorse, affording mighty impressive evidence of stagnation.

The only cargo of ore delivered at a Lake Erie port so far this year was delivered at Cleveland on Monday last by the steamer G. Watson French. Such steamers as carried coal to the head of the lakes under agreements made last fall have returned to Lake Erie light, there being no ore to carry. The grain rate from Duluth has been cut to one cent and the line boats are taking all of it.

PIG IRON SITUATION.

From all parts of the country comes news of the pig iron market which is much more encouraging than at any time since the panic last October. The improvement noted last week has been followed by sales aggregating 70,000 tons of pig iron, by a large southern interest, 5,000 tons of basic at St. Louis, and 6,000 tons to a pipe interest in the east, 10,000 tons at Milwaukee, 6,000 tons to a Chicago foundry, 1,000 tons at Moline, Ill., and many smaller sales. A large volume of inquiries for malleable, basic and No. 2 foundry have been received, and the feeling in the trade is distinctly better. Eagerness of brokers to place orders shows that they have concluded that bottom prices have been reached. While some small sales of No. 2 foundry have been made at $11 Birmingham, the market seems to be firm at $11.50.

The coke market has taken on new life. For 11 months' delivery, a Pittsburg interest has sold 30,000 tons of foundry coke, and an inquiry for 30,000 tons of furnace coke from Wisconsin is about to be closed, while other buyers are out with inquiries.

Buyers of structural material are coming into the market for fair tonnages, while cast iron pipe contracts for large tonnages have just been closed.

As a whole, the finished material market is quiet, but with no expectation that prices will be changed at the New York meeting this week, with possibly the exception of billets.

RULES FOR LAKE CARRIERS' BOATS.

President Livingstone of the lake carriers has sent the following letter to all the members of the association:

"In pursuance of one of the purposes for which our association was formed, viz., to establish and maintain shipping offices for the convenient securing of seamen on vessels on the great lakes, and to establish and maintain amicable relations between employers and employed, and in view of the legislation which goes into effect July 1 of this year, in regard to efficiency of crews, our association from its experience concluded that the best and fairest way to carry out these ideas is through what is commonly known as the 'open shop' principle. To carry this out in its proper spirit and intent requires the co-operation of the owners and the executive officers of the ships.

"The association has established the following shipping offices through which seamen may be employed and every reasonable and proper effort will be made to insure the furnishing of efficient men: Buffalo, Ashtabula, Conneaut, Cleveland, Toledo, Chicago, South Chicago, Milwaukee and Duluth.

"It is essential that the owners and the licensed officers co-operate thoroughly with this effort by obtaining their crews through the established shipping offices and then by insisting throughout that the men have absolutely fair treatment. There must be, so far as possible, watch and watch; no unnecessary work such as scraping and painting, and the like, should be permitted on Sunday; no man should be required or asked to work over the side of the ship while under way. There must be no discriminations in the matter of messrooms, and every complaint from any member of the crew must be received and carefully considered by the master of the ship.

"The executive committee has arranged that the shipping offices issue to each man as shipped a card, giving the date of shipment, the capacity in which employed, and the ship. Where necessity requires the shipment of men at places where there is no shipping office, on arrival at a port where there is a shipping office, such card will be furnished. On reporting on board, the seaman shall give this card to the master, or, if in his department, to the chief engineer, and on leaving ship may require its return, but only with certificate indorsed thereon by the master or chief engineer, according to the department, of the reason for leaving the vessel and statement of qualification and character of service rendered.

"As on many of the docks strangers will be excluded, the card will be an identification of the seaman with the ship, and will serve the very substantial purpose of furnishing a record of men on board our ships in case of accident."

The steamer Suit was sighted in distress by the steamer W. H. Gratwick, was towed into the port of Milwaukee with 8 ft. of water in her hold. The Suit was chartered by the Barry Line to carry freight to Milwaukee while the steamer Kansas was in dry dock.

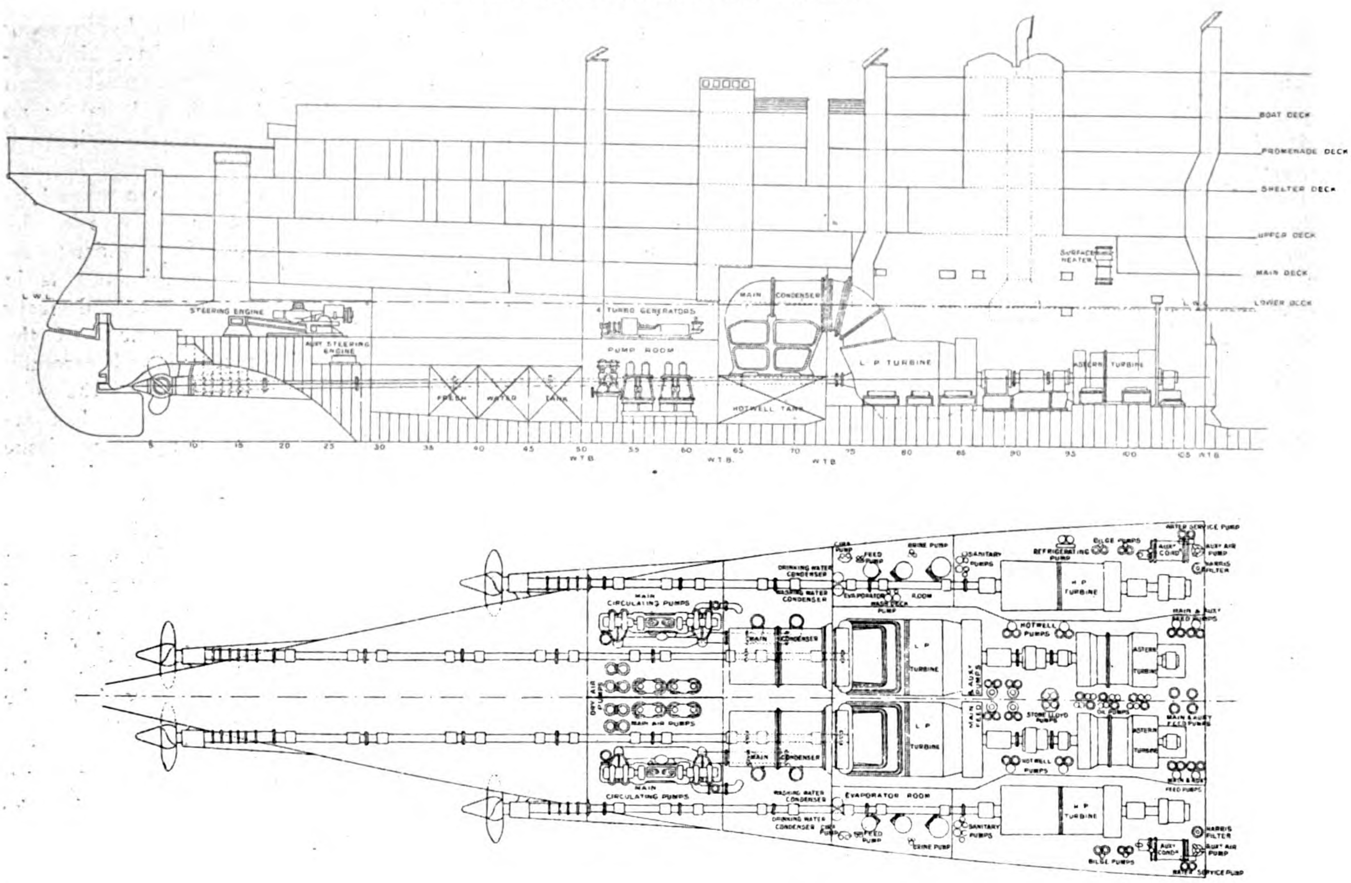
Speed Trials and Service Performance of the Cunard Turbine Steamer Lusitania*

BY THOMAS BELL.

It is with feelings of some diffidence that I place before the members of this institution this brief record of the trials and running in service of the Cunard turbine steamer Lusitania, for, apart altogether from the fact that the propelling machinery consists of Parsons turbines, and is a further practical exemplification of the Hon. C. A. Parsons' wonderful invention; the leading proportions of the design of the ship and machinery are the outcome of most careful deliberations on the part of the technical staff of the Cunard company, of the turbine committee, of the Hon. C. A. Parsons and his assistants, of the British admiralty, of Lloyds committee, and of the board of trade, in conjunction with the staff of the three firms entrusted with the design and construction of the two express Cunarders, so many of whom are distinguished members of this institution. Very full reports of the trials have been published in the technical press, but your council considered that the subject had not yet been exhausted, and it is hoped that this brief paper may furnish material for an interesting discussion on some points connected with this great Cunard enterprise.

Fig 1

ARRANGEMENT OF TURBINES AND SHAFTING



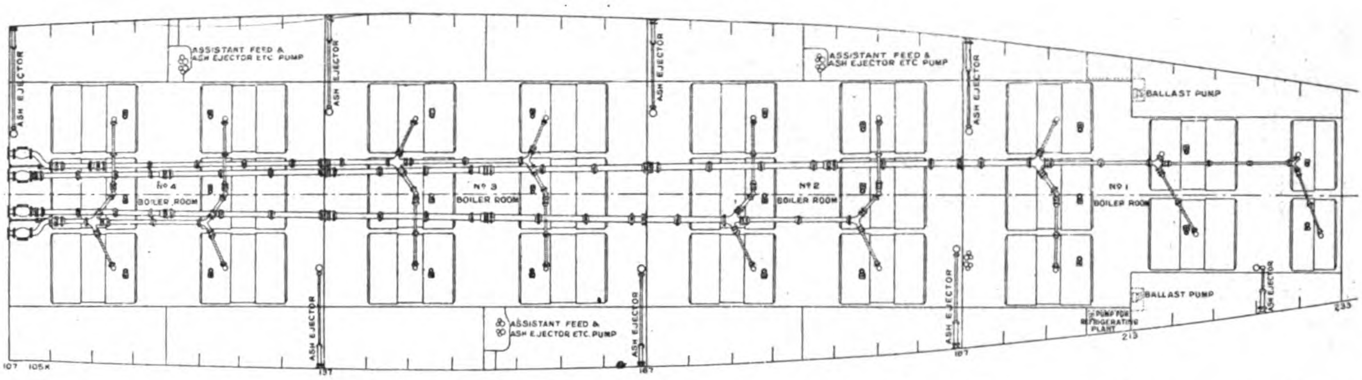
As already described so fully in the technical and other journals, and as shown on accompanying diagrammatic plan, Fig. 1 (Plate 1), the turbine machinery of the Lusitania consists of two pairs of compound turbines, a pair consisting of one high-pressure and one low-pressure unit, each of which actuates a line of shafting, so that there are four lines in all. The high-pressure turbines drive the wing shafts, and the low-pressure turbines the center shafts. At the forward end of the low-pressure turbines are placed the astern turbines. This particular arrangement, in which the two center propellers are used for maneuvering purposes, was forced on the designers by exigencies of space as the only possible one, and has proved most satisfactory.

The boilers, as will be seen from Fig. 2, are divided into four equal groups in separate watertight compartments. The coal bunkers are situated only at the sides in the three after boiler rooms, but in the forward boiler room, owing to the fineness of the ship, the capacity of the side bunkers is comparatively small, and a large athwartship bunker becomes necessary, in addition to those at the sides.

The following are the principal dimensions and particulars of the turbines, condensers, shafting, and boilers:

*Read before the Institution of Naval Architects.

Fig. 2.
ARRANGEMENT OF BOILER ROOMS.



ENGINES.

Turbines.	Diameter of rotor.	Length of Blades. In first expansion.	In last expansion.
H. P.	96 in.	2¾ in.	12⅜ in.
L. P.	140 in.	8¼ in.	22 in.
Astern	104 in.	2¼ in.	8 in.

Total cooling surface, main condensers, 82,800 sq. ft.
Area of exhaust inlet, 158 sq. ft.
Bore of circulating discharge pipes, 32 in.
Diameter of tunnel shafts, 20 in. external, 10 in. hole.
Diameter of propeller shafts, 22 in. external, 10 in. hole.

BOILERS.

Working pressure, 195 lbs. per sq. in.
23 double-ended boilers, 17 ft. 6 in. mean diam. by 22 ft. long.
2 single-ended boilers, 17 ft. 6 in. mean diam. by 11 ft. 4 in. long.
Total number of furnaces, 192.
Total grate surface, 4,048 sq. ft.
Total heating surface, 158,352 sq. ft.
Total length of boiler rooms, 336 ft.
Total length of main and auxiliary engine rooms, 149 ft. 8 in.

With regard to the running of this large machinery and boiler installation, it may be of interest to members to give detailed particulars of the forced lubrication system, and of the system of feed heating and supply to the boilers. Each of these systems demanded that adequate provision be made to meet all possible contingencies, and thus enable the engineers in charge to be free to attend to the numberless duties connected with the supply of electric power and lighting, the supply of hot and cold, fresh and salt water throughout the ship, the pumping of the bilge and of the ballast compartments, and last, but not least, the supervision of the large army of stokers or firemen and trimmers, and the regulation and distribution of the coal supply from the various bunkers.

Regarding the forced lubrication system, of which a diagrammatic sketch is given in Fig. 3, the following statement gives the weights of the various revolving parts, together with the size of bearings and the pressure on same:

A large main drain or reservoir tank is placed amidships low down in the engine room, in such position that the oil from all the bearings readily flows into it; the oil is pumped from this tank by four direct-acting single-cylinder pumps, through a system of filters, to gravitation tanks placed in the engine room casings about 26 feet above the bearings. These tanks are of sufficient capacity to maintain the oil supply to the bearings for 10 or 11 minutes after the complete stoppage of all the pumps. There is a separate and distinct system of supply and gravitation pipes to the bearings on each side of the ship, with cross connections, so that, in the event of any defect arising on one side, it can be at once shut off, and the whole supply to all the turbines directed through the other side. Gages showing the pressure in the oil pump discharges to the filters, and also the pressure in the gravitation pipes to the main bearing journals and thrusts, are fitted up at the starting platform as well as at the pumps, these latter being placed in an easily accessible part of the center engine room. A pressure gage is also fitted at each bearing, and, in addition, the drain or discharge from the bottom reservoir from each bearing and thrust is led through a glass-sided lantern-shaped receiver, so as to make the flow visible, and a thermometer fitted up at this point enables the temperature of the oil from each of the 12 main bearings and four thrust blocks to be taken and recorded, the practice being to log the temperature hourly. In the gravitation tanks are placed copper coils of a total surface of 1,335 square feet, through which cold sea water is circulated, and this

Weight of one H. P. turbine rotor complete, 86 tons.
Weight of one L. P. turbine rotor complete, 120 tons.
Weight of one Astern turbine rotor complete, 62 tons.

	Main Bearing Journals. Diameter.	Effective length.	Pressure per sq. in. of bearing surface.	At 190 revs. surface speed of journal.
H. P. Rotor	27⅛ in.	44¾ in.	80 lbs.	1,350 ft. per min.
L. P. Rotor	33⅛ in.	56½ in.	72 lbs.	1,650 ft. per min.
Astern Rotor	24⅛ in.	34¾ in.	83 lbs.	1,200 ft. per min.

Fig 3
DIAGRAM OF
FORCED LUBRICATION SYSTEM.

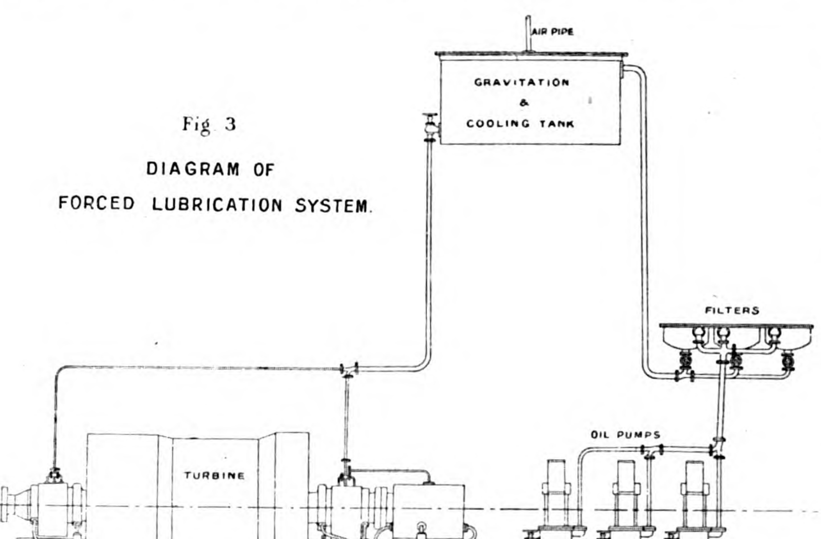
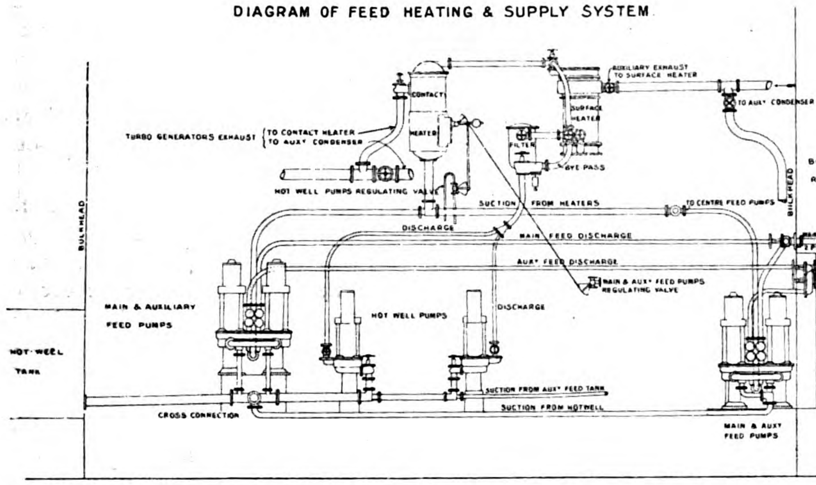


Fig 4

DIAGRAM OF FEED HEATING & SUPPLY SYSTEM



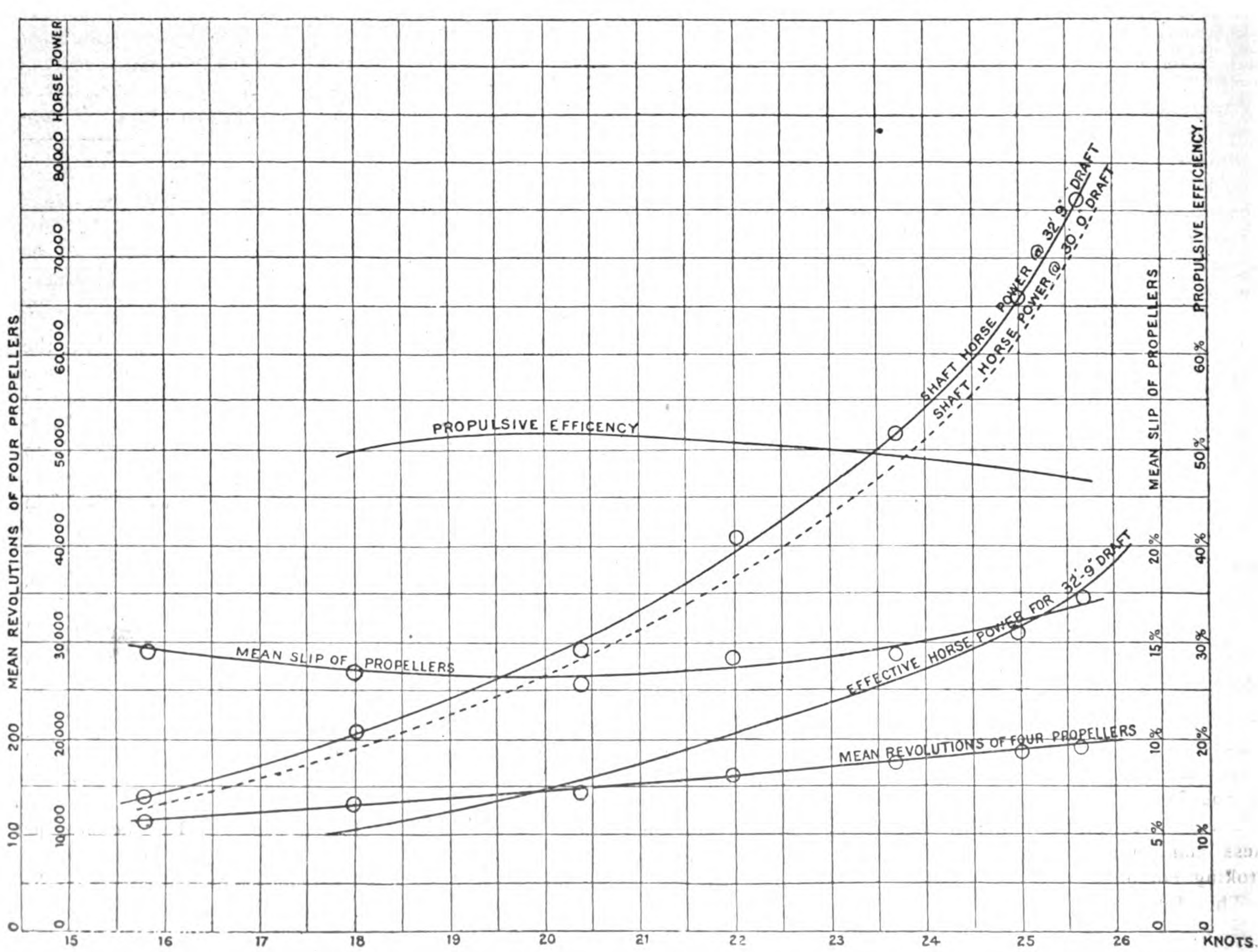
surface suffices to maintain the 4,700 gallons of oil which is in circulation, at a temperature not exceeding 30 degrees above that of the engine room. Each coil is self-contained and withdrawable, so that a leakage of sea water from pitting or other cause can readily be located and repaired without interfering with the general working of the oil supply. There are also reserve oil tanks having a total capacity of 4,200 gallons for use in case of emergency.

Three of the six oil pumps, the discharges from which are all cross-connected, are ample for all the necessary oil supply, but four are kept in use, so that no risk is run in the event of the failure of any single pump not being at once noticed.

With reference to the feed system, shown diagrammatically in Fig. 4 (Plate I), it should be explained that all the auxiliaries in the ship, excepting the turbo-generators and the evaporators, exhaust into a general system of auxiliary exhaust piping connected to the surface feed heaters, auxiliary condensers, and atmosphere. The turbo-generators exhaust into an entirely distinct system of piping connected to the contact feed heaters, auxiliary condensers, and atmosphere. From Fig. 4 it will be seen that the hotwell pumps draw from the hotwell and discharge through two feed filters to the two surface feed heaters, and thence to the contact heaters; these latter constitute the usual feed receivers, and are fitted with float gear, controlling not only the steam supply to the main feed pumps, but also to the hotwell pumps. In addi-

FIG. 5.

PROGRESSIVE TRIAL OFF SKELMORLIE, JULY 27, 1907.



tion, the hotwell pumps are controlled by float gear in the hotwell tanks—the latter, in case of a shortage of water supply, to prevent the pumps running away, and the former precluding the possibility of water being forced back to the turbo-generators, should the non-return valve in the steam inlet to the contact heater fail to act in the event of the feed pumps suddenly slowing.

In most merchant ships, on account of accidents which have occurred, it has been the general practice to lead the exhaust from the electric engines direct to the main or auxiliary condensers only, to ensure steady running of the dynamos and to prevent the possible passing back of water from other auxiliary engines into the cylinders of the electric engines. In this present case the electric installation is so large, and the temperature of the hotwell, due to the high vacuum maintained, so low, that it was considered to be essential to utilize this exhaust for the heating of the feed water, and, by adopting this duplicate system of feed heaters and hotwell control, this end has been attained with a minimum of risk.

Owing to the very great length of feed supply pipes from the feed pumps to the forward boilers, there was considerable speculation as to whether the feed supply to each boiler room would have to be entirely distinct. Had this been so, each pair of feed pumps would have required to be worked entirely independently of the others, and, in the event of any hitch occuring, one of the two pairs of stand-by pumps would have had to be at once connected to the particular boiler room in question. In actual running, however, it was found that the four main feed supply pipes could be cross-connected and made common, thus making any demand for special care and vigilance on this score unnecessary.

With regard to the maintenance of steady steam at sea, although innumerable types of rocking and self-cleaning firebars have been devised and tried in connection with automatic stokers, none of these has been found to give satisfactory results in merchant vessels. The stoking, and especially the cleaning of the fires wherever hard steaming is required, is the same as it was 50 years ago, and, as a consequence, is dependent on the willingness and ability of each unit of the stoking complement of the ship.

The following hourly abstract on one of the watches on the Lusitania brings home to one's mind the loss in steam and speed caused by cleaning fires, especially when the coal is small. It can easily be calculated from this what an appreciable increase in the ship's mean speed could be obtained from this cause alone, if the price and supply would admit of the use of some system of oil fuel burning.

	Mean revolutions.	Corresponding speed of ship.	
First hour	178	about 24 knots	24.15
Second hour ...	181	about 24.3 knots	
Third hour	186	about 25.0 knots	25.05
Fourth hour....	187	about 25.1 knots	
Mean for watch	183	about 24.6 knots	

Regarding the observations from readings taken in the engine room on the official trials generally, it may be stated that on the measured miles the revolutions were obtained from electric records in connection with the pallograph apparatus, but on the lengthened trials they were taken from half-hourly readings of the engine room counters. The vacuum recorded is that of the vapor in the main exhaust orifice forming the top of the condensers, and as measured by a siphon mercury gage, the readings of which throughout are corrected to correspond to a 30 in. barometer. The total quantity of feed water is obtained from hourly counter readings of the double strokes of the Weir's feed pumps, the average length of stroke and the slip or leakage of each pump being determined, both before and after the trials, by careful tests.

The consumption of steam of the auxiliary machinery is obtained by noting the amount by which the temperature of the total feed water was raised in the feed heaters, and to the amount thus found must be added the steam used in turbo-generators, the exhaust from which was led direct to the auxiliary condensers on the official trials. As before stated, in actual service these turbo-generators exhaust into the contact heaters, and thus raise the feed temperature to about 200 degrees. These connections had to be slightly altered at the time of the trials, and unfortunately, therefore, advantage could not then be taken of this additional source of economy.

The torque horsepower was obtained by the Denny-Johnson apparatus, and the records show that, while a propulsive efficiency of the whole installation was obtained which accorded with the original estimate, the steam consumption of the turbines themselves was very satisfactory. It need hardly be pointed out that those two, viz., propulsive efficiency and steam consumption per unit of power, form an excellent check on each other, for, whatever would unduly favor one, would be at the expense of the other.

The Lusitania was floated out of dry dock at Liverpool on July 22, 1907, and was thereafter coaled by the Cunard company, the bunkers for the forward and after boiler rooms being filled with South Wales coal, and those of the two middle boiler rooms with Yorkshire coal.

On her return to the Clyde, on the morning of July 27, a series of progressive runs was made on the Skelmorlie measured mile, as recorded on Table I (at end of paper), with the ship at a mean draught of 32 ft. 9 in. These results are also given in graphical form in the diagram on Fig. 5, which gives curves of shaft horsepower, revolutions, and slip, on a common speed base. Two other most interesting curves have been added, one showing the effective horsepower determined by means of tank experiments, and the other showing the propulsive efficiency. It was intended to repeat this trial at the termination of the official trials at a mean draught of about 30 ft. Unfortunately, however, thick weather on the morning of August 2 prevented this being carried out, but the dotted curve on Fig. 5 indicates with sufficient accuracy what might have been expected.

On the evening of the 27th the Lusitania proceeded on a pleasure cruise round Ireland, during which consumption trials at 18, 21 and 23 knots were carried out, and, after landing the guests in the forenoon of the 29th, the vessel returned to the Clyde, making a consumption trial at 15¾ knots enroute, the results of these trials being given in the first four columns of Table V. After checking the draught of ship, etc., the 48 hours' full speed continuous trial was commenced at midnight. This trial consisted of two double runs on a course of 304 knots between Corsewall Point and the Longships, and the results obtained are recorded on Table II, and the last columns of Table V. The mean draught at starting was 32 ft. 7 in., and at the finish about 30 ft. 8 in. The coal consumed in the 50 hours during which the engines were running at full speed was found by measurement of bunkers to be about 2,200 tons. This represents an evaporation of 10.1 pounds of water per pound of coal from 165 degrees temperature of feed, or 11.1 pounds from and at 212 degrees, and a consumption of coal for all purposes of 1.43 pounds per shaft horsepower per hour, with a rate of combustion of coal of 24.3 pounds per square foot of grate surface per hour. The number of stokers on watch was the same as in actual

Atlantic service, and the air pressure in the ashpits did not exceed ¾-in. of water column. The port evaporators were used for 10 hours of the trial, but, as the vapor from these was condensed in the port auxiliary condenser to which the exhaust from one set of the turbo-generators was led, they were discontinued and the make-up feed obtained from the reserve tanks for the remainder of the time.

The third trial, recorded on Table III, which was commenced in the forenoon of August 1, consisted of one double run between Corsewall Point and the Chicken Rock, a distance of 59 knots each way, but comparison with the dotted curve on Fig. 5 shows that the tide conditions during this trial give altogether too favorable a speed result. The vessel was then headed for Ailsa Craig, and carried out the specified six runs between Ailsa Craig and the Holy Isle (off Arran). These latter, recorded on Table IV, which were run at a mean draught of about 30 ft. 2 in., give a very reliable record of power and speed at this draught, when compared with the 25.62 knots obtained on the measured mile at 32 ft. 9 in. draught. On the following day weather conditions precluded any further trials, and the reversing trial and the steering and circle turning trials were accordingly carried out on the vessel's passage to Liverpool on August 26.

In a fast passenger liner such as the Lusitania, it is of the utmost importance that the maneuvering capabilities should leave nothing to be desired, and to demonstrate the possibilities of the ship in this respect, various trials were made, the most important being the following:

Stopping Trial.—The ship was run on the Skelmorlie measured mile at a speed of 22.8 knots, the average revolutions of the propellers being 166 per minute. On entering the mile, the engine room telegraphs were rung to "full speed astern;" the ship was brought to rest in 3 minutes 55 seconds, the distance run being about three-quarters of a mile, or about six times the length of the ship. During this trial the boilers in the three after boiler rooms only were in use, and the initial pressure at the astern turbines was about 90 pounds.

Circle Trials.—With the ship initially on a straight course and the turbines running at an average speed of 180 revolutions per minute, the steering wheel was put hard over in 17 seconds. The tiller went over to 35 degrees in 20 seconds and the vessel made a complete circle in 5 minutes 50 seconds, the average revolutions coming down at the completion of the circle to 70 per cent of the rate at the commencement. The resulting circular path was approximately 1,000 yards, or four lengths of the ship, in diameter. This maneuver was made both under starboard and port helm with very closely confirmatory results.

Going astern with the inner propellers running at a uniform rate of 136 revolutions per minute and under full helm, resulted in half circles being made in an average time of 6 minutes 45 seconds.

As important factors contributing to these very satisfactory results, it may be remarked that, following on the suggestion of Sir Philip Watts, the deadwood aft is cut away in a fashion similar to that in recent warships. The inner propellers are fairly close together, and as the rudder is of large dimensions in the fore and aft direction, the race from these propellers impinges fully upon it when any helm is used. The vessel, consequently, is very similarly circumstanced to a single screw ship, or a triple screw ship with all three propellers in action, and gets steerage way without any perceptible headway, and this feature was very noticeable during the steering trials. At first sight it would appear that the outer propellers should have been those utilized for maneuvering purposes, as the outer shafts have about three times the spread from the middle line that the inner shafts possess. For turning with propellers alone without the help of the rudder they would have been much the more effective, but they would not have possessed any such advantage as that alluded to above in respect of obtaining steerage way without headway.

Table VI has been compiled for comparison with Table V to show the additional consumption of steam for auxiliary purposes under actual working conditions at sea with the ship full of passengers. This shows very clearly the demand which modern improvements make on the steam, and hence coal consumption, of a large passenger vessel. An additional line has been added to Tables V and VI to show total coal consumption on a voyage of 3,100 nautical miles at the various speeds and under the different conditions.

With reference to the third voyage west, from November 2 to November 8 of last year, thanks to the courteous permission of the chairman of the Cunard company, the leading particulars of the official engine room log are summarized in Table VII. Regarding the mean draught of the vessel at sea, it may be remarked that, after the second day out, certain of the forward tanks were gradually filled for the purpose of avoiding excessive trim, so that the mean draught on November 5, 6 and 7 was approximately 32 ft., or very little more than the mean of the first pair of runs from Corsewall Point to the Longships and back. The conditions, however, were otherwise very different, for, with the exception of the 12 hours of fine weather and smooth sea from noon till shortly after midnight on November 6, it was throughout the average mid-Atlantic winter weather—namely, strong winds and resulting boisterous sea. Up till midnight on the 6th, i. e., for 2,176 knots out of a total of 2,781 knots, the mean speed works out at 24.65 knots per hour; but, unfortunately, early on the 7th the wind freshened, gradually increasing to a furious southwest gale, which reached its height about 4 p. m., and reduced the average speed for the last 24 hours below 23 knots per hour, and thus brought down the mean average for the completed voyage to 24.25 knots per hour. Table VIII giving the mean average speeds at the different stages of the voyage, shows very clearly the effect of this gale, unfortunate so far as preventing the vessel from complying with the contract conditions, but giving those connected with the ship an opportunity of thoroughly satisfying themselves as to her behavior when driving through the huge waves at about 22½ knots, without any racing of engines or sign of laboring, and dispelling the idea, current in some minds, that turbine propelled ships do not show to advantage in heavy weather.

The following particulars of the steam consumption are given in conjunction with the figures of coal consumption set forth in Table VII. Throughout the voyage a careful record of the feed pump counters gave an average of 998,000 pounds of water pumped into the boilers per hour. Of this, about 114,000 pounds was used by auxiliary machinery, exhausting into the feed heaters 26,000 pounds, by the evaporating plant supplying feed make-up and washing water, and about 6,500 pounds for steam to the thermo tanks, galleys and pantries, both of which latter figures are based on data obtained from tests carried out before the vessel left the Clyde. Hence, taking the average shaft horsepower as 65,000, the steam consumption per

			Per shaft horsepower hour
Main turbines	851,500 lbs.	=	13.1 lbs.
Auxiliary machinery	114,000 lbs.	=	1.75 lbs.
Evaporating plant and heating	32,500 lbs.	=	0.5 lbs.
	998,000 lbs.		15.35 lbs.

Average amount of coal burned per hour for all purposes, 43½ tons.
Water evaporated per lb. of coal, 10.2 from a feed temperature of 196 degrees.
Water evaporated per lb. of coal, 10.9 from and at 212 degrees.
Coal for all purposes per shaft horsepower per hour, 1.5 lbs.
Coal per square foot of grate per hour, 24.1 lbs.

shaft horsepower hour works, out as follows:

Taking a mean displacement of 36,000 tons, this represents at 24½ knots per hour a consumption of almost 11 pounds of coal per 100 nautical miles, per ton of displacement. The coal used was half South Wales and half Yorkshire, practically the same as on the official trials.

In the light of present day experiences, the adoption of turbines, even on such an immense scale, appears very different to what it did in the summer of 1903, and too much praise cannot be awarded to the late Lord Inverclyde for his courage and farsightedness, in this as well as in so many other matters, and also to the Cunard board and their technical adviser, James Bain, for so heartily supporting and furthering his progressive views. The largest turbines then constructed by the Turbinia Works were those in the now historic Queen, built by Messrs. Denny, the pioneers of turbine-driven merchant vessels, in which the largest unit weighed some 35 tons, and to suggest jumping at one bound from a 35-ton unit to one of between 400 and 500 tons was most daring. The step has, however, been safely made, and the Hon. C. A Parsons' genius, backed by sound British workmanship, has fully justified the demands made on it and the confidence placed in the possibilities of his marvelous invention.

TABLE I.

R. M. S. LUSITANIA.

PROGRESSIVE TRIAL OFF SKELMORLIE, JULY 27, 1907.
Draught, 32 ft. 9 in. Displacement, 37,080 tons.

Time.	Pressures. H. P. Recr. lbs.	Pressures. L. P. Recr.	Vacuum at 30 in. barometer.	Revs. per minute	Speed in knots.	Shaft H. P.	Slip of propellers, per cent.
First double run	157	5¼ lbs.	28"	194.3	25.62	76,000	17.2
Second double run	135	2⅛ lbs.	27.9"	186.0	25.0	65,500	15.5
Third double run	110	½ lb.	28.1"	174.2	23.7	51,300	14.5
Fourth double run	90	3½ Vacm.	28.1"	161.5	22.02	40,500	14.3
Fifth double run	70	6½" Vacm.	28"	147.6	20.4	29,500	13.1
Sixth double run	50	10½" Vacm.	28"	131.1	18.0	20,500	13.7
Seventh double run	35	14½" Vacm.	28.1"	116.1	15.77	13,400	14.6

TABLE II.

FORTY-EIGHT HOURS' FULL-POWER TRIAL BETWEEN CORSEWALL AND LONGSHIP LIGHTS, JULY 30 TO 31, 1907.
Mean Draught, 31 ft. 7½ in. Mean Displacement, 35,600 tons.

Time.	Pressures. H. P. Recr. lbs.	Pressures. L. P. Recr. lbs.	Vacuum at 30 in. barometer.	Revs. per minute.	Speed in knots.	Shaft H. P.	Slip of propellers, per cent.
First run	146	2½	27.9"	188.8	26.35	70,400	—
Second run	145	2½	28"	187.4	24.3	68,200	—
Third run	146	2½	27.9"	187.5	26.3	68,700	—
Fourth run	148	2½	27.8"	187.9	24.6	68,100	—
Mean of means	146	2½	27.9"	187.9	25.4	68,850	15

TABLE III.

FULL-POWER TRIAL BETWEEN CORSEWALL AND CHICKEN LIGHTS, AUG. 1, 1907.
Draught, 30 ft. 4½ in. Displacement, 34,160 tons.

Time.	Pressures. H. P. Recr. lbs.	Pressures. L. P. Recr. lbs.	Vacuum at 30 in. barometer.	Revs. per minute.	Speed in knots.	Shaft H. P.	Slip of propellers, per cent.
First run	152	2¾	28"	191.3	26.75	72,000	—
Second run	152	2¾	28"	191.7	26.17	72,800	—
Mean	152	2¾	28"	191.5	26.46	72,400	13.2

TABLE IV.

FULL-POWER TRIAL BETWEEN AILSA CRAIG AND HOLY ISLE, AUG. 1, 1907.
Draught, 30 ft. 1 in. Displacement, 33,700 tons.

Time.	Pressures. H. P. Recr. lbs.	Pressures. L. P. Recr. lbs.	Vacuum at 30 in. barometer.	Revs. per minute.	Speed in knots.	Shaft H. P.	Slip of propellers, per cent.
First run	151	2¾	28"	191.3	25.62	72,500	—
Second run	152	2¾	28"	191.1	26.36	72,000	—
Third run	153	3	28"	191.9	25.31	72,000	—
Fourth run	147	2½	28"	191.0	26.16	72,100	—
Fifth run	149	2½	28"	190.2	25.26	70,800	—
Sixth run	149	2½	28"	191.2	25.95	71,800	—
Mean of means	150	2¾	28"	191.2	25.77	71,910	15.3

TABLE V.

ACTUAL STEAM AND COAL CONSUMPTION OF MAIN AND AUXILIARY ENGINES AT VARIOUS SPEEDS UNDER CONDITIONS PREVAILING ON OFFICIAL TRIALS, VIZ., TURBO-GENERATORS EXHAUSTING TO AUXILIARY CONDENSERS, OTHER AUXILIARIES EXHAUSTING TO HEATERS.

Shaft H. P.	13,400	20,500	33,000	48,000	68,850
Speed in knots	15.77	18.0	21.0	23.0	25.4
Total consumption of auxiliaries in pounds per hour	71,000	76,400	85.700	96,700	116,500
Total consumption of turbines in pounds, per hour	284.500	353,600	493,300	668,300	879,500
Steam consumption of auxiliaries in pounds, per H. P. hour	5.3	3.72	2.6	2.01	1.69
Steam consumption of turbines in pounds, per H. P. hour	21.23	17.24	14.91	13.92	12.77
Total steam consumption in pounds, per H. P. hour	26.53	20.96	17.51	15.93	14.46
Temperature of feed water	200°	200°	199°	179°	165°
Coal consumption in pounds, per H.P. hour	2.52	2.01	1.68	1.56	1.43
Estimated coal consumption in tons on a voyage of 3,100 nautical miles, allowing 20 tons for galleys, etc	2,980	3,190	3,670	4,520	5,390

NAVAL BILL PASSED.

The naval appropriation bill, which carries an increase of pay for officers and enlisted men of the navy, was adopted in both the senate and house on report of the conferrees. Navy officers are to be paid hereafter according to the following schedule agreed upon as a compromise of the navy pay amendment added to the bill by the senate:

Admiral, $13,500; rear admiral, first nine, $8,000; rear admiral, second nine or commodore, $6,000; captain, $4,000; commander, $3.500; lieutenant-commander, $3,000; lieutenant, $2,400; lieutenant, junior grade, $2,000; ensign, $1,700. Each commissioned officer below the rank of rear admiral gets 10 per cent additional of his current yearly pay for each term of five years' service in the army, navy, and marine corps. All officers on sea duty and all officers on shore duty beyond the continental limits of the United States shall receive 10 per cent additional of their salaries.

The total amount of appropriations carried by the bill is $122,662,715.

The Erie street bridge which spans the north branch of the Chicago river collapsed last week. The structure was 201 ft. long and 24 ft wide. The draw has been so swung that navigation is not blocked.

The steamer John Stanton, which struck at Houghton, has arrived at Lorain.

TABLE VI.

ESTIMATED STEAM AND COAL CONSUMPTION AT VARIOUS SPEEDS ALLOWING FOR THE ADDITIONAL AUXILIARY STEAM CONSUMPTION FOUND REQUISITE UNDER ACTUAL SERVICE CONDITIONS FOR THE WASHING WATER SUPPLY, ETC., WITH A FULL COMPLEMENT OF PASSENGERS, WEATHER CONDITIONS BEING AS ON OFFICIAL TRIAL.

Shaft H. P.	13,400	20,500	33,000	48,000	68,850
Speed in knots	15.77	18.0	21.0	23.0	25.4
Total consumption of auxiliaries in pounds, per hour	93,500	100,900	112,700	127,500	149,700
Total consumption of turbines in pounds, per hour	284,500	353,600	493,300	668,300	879,500
Steam consumption of auxiliaries in pounds, per H. P. hour	6.97	4.92	3.41	2.65	2.17
Steam consumption of turbines in pounds, per H. P. hour	21.23	17.24	14.91	13.92	12.77
Total steam consumption in pounds, per H. P. hour	28.2	22.16	18.32	16.57	14.94
Temperature of feed water	200°	200°	200°	200°	200°
Coal consumption in pounds, per H. P. hour	2.76	2.17	1.8	1.62	1.46
Estimated coal consumption in tons on a voyage of 3,100 nautical miles, allowing 20 tons for galleys, etc	3,270	3,440	3,930	4,700	5,490

TABLE VII.

ABSTRACT OF ENGINE ROOM LOG FOR THIRD VOYAGE WEST: QUEENSTOWN TO NEW YORK.

Date when last dry docked, July 22, 1907. Mean draught, leaving Queenstown, 33 ft. 7 in. Mean draught, arriving New York, 30 ft. 10. in.

Date—1907.	Steam Pressures — Boilers, lbs.	H. P. Recrs., lbs.	L. P. Recrs., lbs.	Temperatures — Hot well.	Feed water.	Vacuum.	Barometer.	Length of Day. Hours.	Minutes.	Distance by observation, knots.	Mean speed.	Means revolutions.	Mean slip, per cent.	Coal consumed for main and auxiliary engines, tons.
Noon, Nov. 3	170	140.0	2.3	68°	200°	28″	30.4″	...	52	21	24.24	182.5	16.5	40
Noon, Nov. 4	169.1	142.2	2.2	78°	197°	28″	29.7″	24	57	606	24.28	182.6	16.4	1,090
Noon, Nov. 5	167.3	140.6	2.3	78°	198°	28.2″	30″	25	2	616	24.6	182.8	15.4	1,090
Noon, Nov. 6	168.3	140.4	2.5	70°	196°	28.2″	30.1″	24	55	618	24.8	183.5	15.1	1,090
Noon, Nov. 7	168.3	138.3	2.2	72°	195°	28″	29.6″	24	52	610	24.52	181.4	15.0	1,090
1:14 a. m. Nov. 8	165	132.5	1.5	75°	200°	27.8″	29.3″	14	2	310	22.09	174	20.2	576*
Means	168	139.3	2.2	74.5°	197°	28.1″	29.8″	Total 114	40	Total of 2,781	24.25	181.1	15.9	4.976

*This includes all coal used till 10 a. m. on the 9th.

Summary of Total Coal Consumed on Voyage:—Liverpool to Queenstown, 408 tons; Queenstown to New York, 4,976 tons; galleys, etc., 18 tons. Total coal taken from bunker from leaving Landing Stage, Liverpool, till moored at wharf, New York, 5,402 tons.

Passage—Queenstown to Sandy Hook—Four days, 18 hours, 40 minutes.

TABLE VIII.

Date—1907.	Length of steaming day. Hrs.	Min.	Distance run.	Speed.	Total knots steamed.	Total time. Hrs.	Min.	Mean average speed.
Noon, Nov. 3	0	52	21 knots	24.24	21	0	52	24.24
Noon, Nov. 4	24	57	606 knots	24.28	627	25	49	24.27
Noon, Nov. 5	25	02	616 knots	24.6	1,243	50	51	24.44
Noon, Nov. 6	24	55	618 knots	24.8	1,861	75	46	24.57
Noon till midnight, Nov. 6	12	30	315 knots	25.2	2,176	88	16	24.65
Noon, Nov. 7	12	22	295 knots	23.85	2,471	100	38	24.55
Morning, Nov. 8	14	02	310 knots	22.09	2,781	114	40	24.25
	114	40	2,781 knots					

ATLANTIC COAST GOSSIP.

Office of the MARINE REVIEW,
Room 1005, No. 90 West St.,
New York City.

It has been announced that the name of the vessel now under construction at the Harland & Wolff yard, Belfast, for the International Mercantile Marine Co., will be the Lapland. She will go into the Red Star Line service between New York, Dover and Antwerp, and will be the largest vessel of the fleet.

Representative Greene's bill to protect New York harbor from injurious or unhealthy deposits was passed by the house on Many 15. The measure forbids scows to receive garbage without first getting a permit from the supervisor of the harbor, defining the limits within which the refuse may be dumped, and empowers inspectors to arrest without process persons for violation. The inspectors may also enter gas, oil or other manufacturing works for the purpose of seeing that no acids or other injurious substances are permitted to enter the tidal waters of the harbor.

An Annapolis, Md., correspondent of the *New York Sun* expresses his surprise that the logical, if not philological, origin of the term "dog watch" is not better known. When a small boy he was told that it was so called because it was cur-tailed.

The new Italian steamship Taormina, built for the Italia Societa di Navigazione a Vapore by William Henderson & Co., Ltd., Glasgow, has completed her trials on the Clyde and will go into service between New York, Genoa and Naples in the near future. The Taormina is 500 ft. in length; breadth, 58 ft; depth, 37.3 ft., with a gross tonnage of 9,000. She has been especially designed for the New York-Mediterranean service, and has in addition to accommodation for 2,500 emigrants, rooms for 60 first class passengers. On her trials she maintained an average speed of over 16 knots.

Work has been started on the new lighthouse at the Delaware breakwater, for which an appropriation was made some time ago. When completed the light will be one of the most important along the coast.

It is said that officers of unions in the trades employed in the ship yards around New York and vicinity report more activity than at any time since last fall, when the works began to lay men off, and that the improvement is increasing every week. Well, what did we say?

The funeral of Capt. John B. Beevor, of the Houston Line steamship Hostilius, who was accidentally drowned in Atlantic basin, New York harbor, on April 3, was held in St. Ann's Episcopal church, Brooklyn, last week, the remains being interred in Greenwood cemetery. It is believed Capt. Beevor fell between the pier and his ship, having missed his footing in the dark while going aboard his vessel. The body was not recovered until last week.

The steamboat inspection service is now busy with the task of going over the excursion fleet for the coming season.

CONSERVING OUR NATIONAL RESOURCES.

One of the most important conferences ever held in the country took place in the east room of the White House last week. It was a conference of governors of states and leaders in the industrial world called together by President Roosevelt to consider the conservation of the natural resources of the United States. Those naturally most familiar with the drain upon raw material were the leaders of industry. Representing the government was the president of the United States, the vice president, the cabinet, justices of the United States supreme court and members of both houses of congress. The states were represented by their chief executives and the conferers appointed by them. The industries were represented by Andrew Carnegie, iron master; James J. Hill, of the Great Northern railway; John Mitchell, labor leader; Wm. Livingstone, president of the Lake Carriers' Association; Dr. I. C. White, state geologist of West Virginia. The specially invited guests were the three democratic presidential possibilities—William Jennings Bryan, Judge George Gray, of Delaware; and Governor John A. Johnson, of Minnesota.

The subjects considered were the conservation of mineral resources, resources of the land, and resources of the waters. President Roosevelt spoke steadily for 55 minutes and was listened to with profound attention. He especially emphasized the necessity of continuing the inland waterways commission, remarking parenthetically that the "commission ought to be perpetuated and if congress does not see fit to do so, I shall do so myself." The text of the president's talk was as follows:

Governors of the several states; and gentlemen: I welcome you to this conference at the White House. You have come hither at my request so that we may join together to consider the question of the conservation and use of the great fundamental sources of wealth of this nation. So vital is this question that for the first time in our history the chief executive officers of the states separately, and of the states together forming the nation, have met to consider it.

With the governors come men from each state chosen for their special acquaintance with the terms of the problem that is before us. Among them are experts in natural resources and representatives of national organizations concerned in the development and use of these resources; the senators and representatives in congress; the supreme court, the cabinet, and the Inland Waterways Commission have likewise been invited to the conference, which is, therefore, national in a peculiar sense.

This conference on the conservation of natural resources is in effect a meeting of the representatives of all the people of the United States called to consider the weightiest problem now before the nation; and the occasion for the meeting lies in the fact that the natural resources of our country are in danger of exhaustion if we permit the old wasteful methods of exploiting them longer to continue.

With the rise of peoples from savagery to civilization, and with the consequent growth in the extent and variety of the needs of the average man, there comes a steadily increasing growth of the amount demanded by this average man from the actual resources of the country. Yet, rather curiously, at the same time the average man is apt to lose his realization of this dependence upon nature.

Savages, and very primitive peoples generally, concern themselves only with superficial natural resources; with those which they obtain from the actual surface of the ground. As peoples become a little less primitive, their industries, although in a rude manner, are extended to resources below the surface; then, with what we call civilization and the extension of knowledge, more resources come into use, industries are multiplied, and foresight begins to become a necessary and prominent factor in life. Crops are cultivated; animals are domesticated; and metals are mastered.

Every step of the progress of mankind is marked by the discovery and use of natural resources previously unused. Without such progressive knowledge and utilization of natural resources population could not grow, nor industries multiply, nor the hidden wealth of the earth be developed for the benefit of mankind.

RAPID PACE OF PRESENT-DAY LIVING.

From the first beginning of civilization, on the banks of the Nile and the Euphrates, the industrial progress of the world has gone on slowly, with occasional setbacks, but on the whole steadily, through tens of centuries to the present day. But of late the rapidity of the process has increased at such a rate that more space has been actually covered during the century and a quarter occupied by our national life than during the preceding six thousand years that take us back to the earliest monuments of Egypt, to the earliest cities of the Babylonian plain.

When the founders of this nation met at Independence hall in Philadelphia the conditions of commerce had not fundamentally changed from what they were when the Phoenician keels first furrowed the lonely waters of the Mediterranean. The differences were those of degree, not of kind, and they were not in all cases even those of degree. Mining was carried on by the Pharaohs in the countries adjacent to the Red sea.

The wares of the merchants of Boston, of Charleston, like the wares of the merchants of Nineveh and Sidon, if they went by water, were carried by boats propelled by sails or oars; if they went by land were carried in wagons drawn by beasts of draught or in packs on the backs of beasts of burden. The ships that crossed the high seas were better than the ships that had once crossed the Aegean, but they were of the same type, after all—they were wooden ships propelled by sails; and on land, the roads were not as good as the roads of the Roman empire, while the service of the posts was probably inferior.

In Washington's time anthracite coal was known only as a useless black stone; and the great fields of bituminous coal were undiscovered. As steam was unknown, the use of coal for power production was undreamed of. Water was practically the only source of power, save the labor of men and animals; and this power was used only in the most primitive fashion. But a few small iron deposits had been found in this country, and the use of iron by our countrymen was very small. Wood was practically the only fuel, and what lumber was sawed was consumed locally, while the forests were regarded chiefly as obstructions to settlement and cultivation.

Such was the degree of progress to which civilized mankind had attained when this nation began its career. It is almost impossible for us in this day to realize how little our revolutionary ancestors knew of the great store of natural resources whose discovery and use have been such vital factors in the growth and greatness of this nation, and how little they required to take from this store in order to satisfy their needs.

RESOURCES AND GROWTH OF THE UNITED STATES.

Since then our knowledge and use of the resources of the present territory of the United States have increased a hundredfold. Indeed, the growth of this nation by leaps and bounds makes one of the most striking and important chapters in the history of the world. Its growth has been due to the rapid development, and alas that it should be said, to the rapid destruction, of our natural resources. Nature has supplied to us in the United States, and still supplies to us, more kinds of resources in a more lavish degree than has ever been the case at any other time or with any other people. Our position in the world has been attained by the extent and thoroughness of the control we have achieved over nature; but we are more, and not less, dependent upon what she furnishes than at any previous time of history since the days of primitive man.

Yet our fathers, though they knew so little of the resources of the country, exercised a wise forethought in reference thereto. Washington clearly saw that the perpetuity of the states could only be secured by union, and that the only feasible basis of union was an economic one; in other words, that it must be based on the development and use of their natural resources. Accordingly, he helped to outline a scheme of commercial development, and by his influence an interstate waterways commission was appointed by Virginia and Maryland.

It met near where we are now meeting, in Alexandria, adjourned to Mount Vernon, and took up the consideration of interstate commerce by the only means then available, that of water. Further conferences were arranged, first at Annapolis and then at Philadelphia. It was in Philadelphia that the representatives of all the states met for what was in its original conception merely a waterways conference; but when they had closed their deliberations the outcome was the constitution which made the states into a nation.

The constitution of the United States thus grew in large part out of the necessity for united action in the wise use of one of our natural resources. The wise use of all of our natural resources, which are our national resources as well, is the great material question of today. I have asked you to come together now because the enormous consumption of these resources, and the threat of imminent exhaustion of some of them, due to reckless and wasteful use, once more calls for common effort, common action.

Since the days when the constitution was adopted, steam and electricity have revolutionized the industrial world. Nowhere has the revolution been so great as in our own country. The discovery and utilization of mineral fuels and alloys have given us the lead over all other nations in the production of steel. The discovery and utilization of coal and iron have given us our railways, and have led to such industrial development as has never before been seen. The vast wealth of lumber in our forests, the riches of our soils and mines, the discovery of gold and mineral oils, combined with the efficiency of our transportation, have made the conditions of our life unparalleled in comfort and convenience.

PRESENT DRAIN ON OUR RESOURCES.

The steadily increasing drain on these natural resources has promoted to an extraordinary degree the complexity of our industrial and social life. Moreover, this unexampled development has had a determining effect upon the character and opinions of our people. The demand for efficiency in the great task has given us vigor, effectiveness, decision, and power, and a capacity for achievement which in its own lines has never yet been matched. So great and so rapid has been our material growth that there has been a tendency to lag behind in spiritual and moral growth; but that is not the subject upon which I speak to you today.

Disregarding for the moment the question of moral purpose, it is safe to say that the prosperity of our people depends directly on the energy and intelligence with which our natural resources are used. It is equally clear that these resources are the final basis of national power and perpetuity. Finally, it is ominously evident that these resources are in the course of rapid exhaustion.

This nation began with the belief that its landed possessions were illimitable and capable of supporting all the people who might care to make our country their home; but already the limit of unsettled land is in sight, and, indeed, but little land fitted for agriculture now remains unoccupied, save what can be reclaimed by irrigation and drainage. We began with an unapproached heritage of forests; more than half of the timber is gone. We began with coal fields more extensive than those of any other nation, and with iron ores regarded as inexhaustible, and many experts now declare that the end of both iron and coal is in sight.

The mere increase in our consumption of coal during 1907 over 1906 exceeded the total consumption in 1876, the centennial year. The enormous stores of mineral, oil and gas are largely gone. Our natural waterways are not gone, but they have been so injured by neglect, and by the division of responsibility and utter lack of system in dealing with them, that there is less navigation on them now than there was 50 years ago. Finally, we began with soils of unexampled fertility, and we have so impoverished them by injudicious use and by failing to check erosion that their crop producing power is diminishing instead of increasing. In a word, we have thoughtlessly, and to a large degree unnecessarily, diminished the resources upon which not only our prosperity but the prosperity of our children must always depend.

We have become great because of the lavish use of our resources, and we have just reason to be proud of our growth. But the time has come to inquire seriously what will happen when our forests are gone, when the coal, the iron, the oil, and the gas are exhausted, when the soils shall have been still further impoverished and washed into the streams, polluting the rivers, denuding the fields, and

obstructing navigation. These questions do not relate only to the next century or to the next generation. It is time for us now as a nation to exercise the same reasonable foresight in dealing with our great natural resources that would be shown by any prudent man in conserving and widely using a property which contains the assurance of well-being for himself and his children.

TWO CLASSES OF RESOURCES.

The natural resources I have enumerated can be divided into two sharply distinguished classes accordingly as they are or are not capable of renewal. Mines, if used, must necessarily be exhausted. The minerals do not and cannot renew themselves. Therefore, in dealing with the coal, the oil, the gas, the iron, the metals generally, all that we can do is to try to see that they are wisely used. The exhaustion is certain to come in time.

The second class of resources consists of those which can not only be used in such manner as to leave them undiminished for our children, but can actually be improved by wise use. The soil, the forests, the waterways come in this category. In dealing with mineral resources, man is able to improve on nature only by putting the resources to a beneficial use which in the end exhausts them; but in dealing with the soil and its products man can improve on nature by compelling the resources to renew and even reconstruct themselves in such manner as to serve increasingly beneficial uses—while the living waters can be so controlled as to multiply their benefits.

Neither the primitive man nor the pioneer was aware of any duty to posterity in dealing with the renewable resources. When the American settler felled the forests, he felt that there was plenty of forest left for the sons who came after him. When he exhausted the soil of his farm he felt that his son could go west, and take up another. So it was with his immediate successors. When the soil-wash from the farmer's fields choked the neighboring river he thought only of using the railway rather than boats for moving his produce and supplies.

Now all this is changed. On the average the son of the farmer today must make his livng on his father's farm. There is no difficulty in doing this if the father will exercise wisdom. No wise use of a farm exhausts its fertility. So with the forests. We are over the verge of a timber famine in this country, and it is unpardonable for the nation or the states to permit any further cutting of our timber, save in accordance with a system which will provide that the next generation shall see the timber increased, instead of diminished. Moreover, we can add enormous tracts of the most valuable possible agricultural land to the national domain by irrigation in the arid and semi-arid regions and by drainage of great tracts of swamp land in the humid regions. We can enormously increase our transportation facilities by the canalization of our rivers so as to complete a great system of waterways on the Pacific, Atlantic, and Gulf coasts and in the Mississippi valley, from the Great Plains to the Alleghenies, and from the northern lakes to the mouth of the mighty Father of Waters. But all these various uses of our natural resources are so closely connected that they should be co-ordinated, and should be treated as part of one coherent plan, and not in haphazard and piece-meal fashion.

It is largely because of this that I appointed the Waterways Commission last year, and that I have sought to perpetuate its work. I wish to take this opportunity to express in heartiest fashion my acknowledgment to all the members of the commission. At great personal sacrifice of time and effort they have rendered a service to the public for which we cannot be too grateful. Especial credit is due to the initiative, the energy, the devotion to duty, and the far-sightedness of Gifford Pinchot, to whom we owe so much of the progress we have already made in handling this matter of the co-ordination and conservation of natural resources. If it had not been for him this convention neither would nor could have been called.

DUTY OF THE NATION.

We are coming to recognize as never before the right of the nation to guard its own future in the essential matter of natural resources. In the past we have admitted the right of the individual to injure the future of the republic for his own present profit. The time has come for a change. As a people, we have the right and the duty, second to none other but the right and duty of obeying the moral law, of requiring and doing justice, to protect ourselves and our children against the wasteful development of our natural resources, whether that waste is caused by the actual destruction of such resources or by making them impossible of development hereafter.

Any right-thinking father earnestly desires and strives to leave his son both an untarnished name and a reasonable equipment for the struggle of life. So this nation, as a whole should earnestly desire and strive to leave to the next generation the national honor unstained and the national resources unexhausted. There are signs that both the nation and the states are waking to a realization of this great truth. On March 10, 1908, the supreme court of Maine rendered an exceedingly important judicial decision. This opinion was rendered in response to questions as to the right of the legislature to restrict the cutting of trees on private land for the prevention of droughts and floods, the preservation of the natural water supply, and the prevention of the erosion of such lands, and the consequent filling up of rivers, ponds and lakes. The forests and water power of Maine constitute the larger part of the wealth and form the basis of her industrial life, and the question submitted by the Maine senate to the supreme court and the answer of the supreme court alike bear testimony of the wisdom of the people of Maine, and clearly define a policy of conservation of natural resources, the adoption of which is of vital importance, not merely to Maine, but to the whole country.

POLICY OF PRESERVATION.

Such a policy will preserve soil, forests, water power as a heritage for the children and the children's children of the men and women of this generation; for any enactment that provides for the wise utilization of the forest, whether in public or private ownership, and for the conservation of the water resources of the country, must necessarily be legislation that will promote both private and public welfare; for flood prevention, water-power development, preservation of the soil, and improvement of navigable rivers are all promoted by such a policy of forest conservation.

The opinion of the Maine supreme bench sets forth unequivocally the principle that the property rights to the individual are subordinate to the rights of the community, and especially that the waste of wild timber land derived originally from the state, involving as it would the impoverishment of the state and its people, and thereby defeating one great purpose of government, may properly be prevented by state restrictions.

The court says that there are two reasons why the right of the public to control and limit the use of private property is peculiarly applicable to property in land: "First, such property is not the result of productive labor, but is derived solely from the state itself, the original owner; second, the amount of land being incapable of increase, if the owners of large tracts can waste them at will without state restriction, the state and its people may be helplessly impoverished and one great purpose of government defeated * * * We do not think the proposed legislation would operate to 'take' private property within the inhibition of the constitution. While it might restrict the owner of wild and uncultivated lands in his use of them, might delay his taking some of the product, might delay his anticipated profits, and even thereby might cause him some loss of profit, it would nevertheless leave him his lands, their product and increase, untouched, and without diminution of title, estate, or quantity. He would still have large measure of control and large opportunity to realize values. He might suffer delay but not privation. * * * The proposed legislation * * * would be within the legislative power and would not operate as a taking of private property for which compensation must be made."

The court of errors and appeals of New Jersey has adopted a similar view, which has recently been sustained by the supreme court of the United States. In delivering the opinion of the court on April 6, 1908, Justice Holmes said: "The state as quasi-sovereign and representative of the interests of the public has a standing in court to protect the atmosphere, the water, and the forests within its territory, irrespective of the assent or dissent of the private owners of the land most immediately concerned. * * * It appears to us that few public interests are more obvious, indisputable, and independent of particular theory than the interest of the public of a state to maintain the rivers that are wholly within it substantially undiminished, except by such drafts upon them as the guardian of the public welfare may permit for the purpose of turning them to a more perfect use. This public interest is omnipresent wherever there is a state, and grows more pressing as population grows. * * * We are of opinion, further, that the constitutional power of the state to insist that its natural advantages shall remain unimpaired by its citizens is not dependent upon any nice estimate of the extent of present use or speculation as to future needs. The legal conception of the necessary is apt to be confined to somewhat rudimentary wants, and there are benefits from a great river that might escape a lawyer's view. But the state is not required to submit even to an aesthetic analysis. Any analysis may be inadequate. It finds itself in possession of what all admit to be a great public good, and what it has it may keep and give no one a reason for its will."

These decisions reach the root of the idea of conservation of our resources in the interests of our people.

ANOTHER GREATER PROBLEM.

Finally, let us remember that the conservation of our natural resources, though the gravest problem of today, is yet but part of another and greater problem to which this nation is not yet awake, but to which it will awake in time, and with which it must hereafter grapple if it is to live—the problem of national efficiency, the patriotic duty of insuring the safety and continuance of the nation. When the people of the United States consciously undertake to raise themselves as citizens, and the nation and the states in their several spheres, to the highest pitch of excellence in private, state, and national life, and to do this because it is the first of all the duties of true patriotism, then and not till then the future of this nation, in quality and in time, will be assured.

Obviously anything that a man, capable of transforming $1,200 of borrowed money into $300,000,000 of his own, might say would be interesting. Andrew Carnegie took as his theme "The Conservation of Ores and Minerals." His address was especially valuable owing to his undoubted sources of information. He sounded a note of warning, saying that other material must come to the relief of iron which will in the not distant future be unable to meet the demands upon it. Mr. Carnegie said:

Of all the world's metals, iron is in our day the most useful. The opening of the iron age marked the beginning of real industrial development. The mining of copper and tin, and the making of bronze implements closed the stone age in Europe and Asia, but it was not until the smelting of iron started in Africa and spread to Europe that industrial progress began: in all countries the highest civilization has followed the use of iron in the arts and crafts. Today the position of nations may almost be measured by its production and use.

Iron and coal are the foundation of our industrial prosperity. The value of each depends upon the amount and nearness of the other. In modern times the manufacturing and transportation industries rest upon them, and, given sufficient land area and fertile soil, these determine the progress of any people. When the United States entered upon its unexampled career, the extent and value of our deposits of iron and coal were unknown. It was only through the growth of population, increase of knowledge, and invention, that they gained such value as to render their quantity an important public question. Iron smelting began with charcoal made in neighboring forests. Electrical smelting by means of water-power has only recently been tried. Today the reduction of our ores and the manufacture of iron practically rest upon the extent and availability of our coal.

When the republic was founded, there were, according to recent expert estimates, approximately 2,000,000,000,000 tons of coal in the territory now forming the United States. Practically none of this supply was used for over a quarter century; but during the 75 years from 1820 to 1895 nearly 4,000,000,000 tons were mined by methods so wasteful that some 6,000,000,000 tons were either destroyed or allowed to remain in the ground, forever inaccessible. During the 10 years from 1896 to 1906 as much was produced as during the preceding 75 years; while more than 3,000,000,000 tons were destroyed or left in the ground, beyond reach of future use. To date the actual consumption of coal has been over 7,500,000,000 tons; the waste and destruction in the neighborhood of 9,000,000,000 tons. If mining were perfected from now forward, we might reckon that considerably less than 1 per cent of our original stock has been consumed: but, estimating on the basis of the wasteful methods hitherto pursued, nearly 2 per cent of our available supply is gone.

Coal consumption is increasing at an astonishing rate. During the period for which statistics have been gathered, it has doubled during each decade; of late it has more than doubled. In 1907 the production was about 450,000,000 tons. At the present rate of increase, the production in 1917 will be 900,000,000 tons, in 1927 1,800,000,000 tons, and in 1937 over 3,500,000,000 tons, or an amount in that year alone nearly equal to the production of the 75 years ending in 1895; and, with continuation of the wasteful methods of mining, the consumption and destruction together during that one year would equal our total

useful production up to the present date. And at that time—which many of us will live to see—more than an eighth of our estimated original supply will have been consumed or destroyed.

OUTLOOK FOR NEXT CENTURY.

All estimates of future consumption and destruction of coal are liable to error; yet, making all reasonable allowance, unless there be careful husbanding, or revolutionizing inventions, or some industrial revolution comes which cannot now be foreseen, the greater part of that estimated 2,500,000,000,000 tons of coal forming our original heritage will be gone before the end of the next century, say, 200 years hence.

To each generation the ultimate disappearance of coal is of less concern than current prices. With the working out of seams and fields, plants and transportation facilities are removed or abandoned, and other losses are incurred; and the cost of these in the end increases prices. Already this is felt; it is estimated that by reason of the progressive exhaustion of American fields, coal consumers are today paying on an average 10 per cent or 15 per cent more than would be necessary if the supply were unlimited—and the advance must continue with each decade as the supply lessens.

Still more wasteful than our processes of mining are our methods of consuming coal. Of all the coal burned in the power plants of the country, not more than from 5 to 10 per cent of the potential energy is actually used; the remaining 90 per cent to 95 per cent is absorbed in rendering the smaller fraction available in actual work. In direct heating the loss is less, but in electric heating and lighting it is much more—indeed, in ordinary electric light plants hardly one-fifth of 1 per cent, one five-hundredth part ,of the energy of the coal, is actually utilized. There is at present no known remedy for this. These wastes are not increasing; fortunately, through the development of gas producers, internal-combustion engines, and steam turbines they are constantly decreasing; yet not so rapidly as to affect seriously the estimates of increase in coal consumption. We are not without hope, however, of discoveries that may yet enable man to convert potential into mechanical energy direct, avoiding this fearful waste. If that day ever comes, our coal supply might be considered unending.

The same spirit of recklessness that leads to waste in mining and in the consumption of coal leads to unnecessary risk of human life. During the year 1907 in the United States the killed and wounded in coal mining operations exceeded 9,000. The danger to life and limb in the mines is increasing far more rapidly than production, because gas becomes more abundant and the work of rescue more difficult as the mines extend deeper or farther from the entrance.

IRON.

When the republic was started in 1776 little iron was used. Each family was content with a few score pounds in the form of implements, utensils, and weapons, so that the average annual consumption was but a few pounds per capita. In 1907 alone the production of iron ore in the United States was 53,000,000 tons, or more than 1,200 pounds for each man, woman and child of our 88,000,000 population. And the production is steadily increasing.

The latest trustworthy estimates of our present stock of iron ore are: For the Lake Superior district, about 1,500,000,000 tons; for the southern district (including Alabama, Georgia, Tennessee, and Virginia), about 2,500,000,000 tons; and for the rest of the United States, 5,000,000,000 to 7,000,000,000 tons—making an aggregate of about 10,000,000,000 tons. * * *

The total production of iron ore in the United States up to 1890 was some 275,000,000 tons; in the next 10 years it was nearly 200,000,000, and in the seven years from 1901 to 1907 more than 270,000,000 tons were produced, or nearly as much as the total for the first century of our history. The aggregate production to date, 750,000,000 tons, is about one-thirteenth of the estimated original supply. At the recent rate of increase (doubling each decade) the production in 1918 will exceed 100,000,000 tons, by 1928, 200,000,000 tons, and by 1938 it will be over 400,000,000 tons—i. e., in that single year, which many of us may expect to see, an amount approximating the entire production in the United States up to the close of last year. By that date about half of the original supply will be gone, and only the lower grades of ore will remain; and all the ore now deemed workable will be used long before the end of the present century.

COPPER.

Next to iron our most useful metal is copper. It was the only metal used effectively by the natives of North America before Columbus landed; and for over three centuries native copper was mined and wrought by white men chiefly in Indian mines and by Indian methods. The mining and reduction of copper ores has grown up within 50 years; and within a dozen years the copper industry has been revolutionized through electrical application. Although production is enormous and increasing apace, it fails to keep up with the demand, which more than in any other commodity is limited by price. If the current price could be reduced 35 per cent, the demand would be doubled or tripled; if it could be reduced 50 per cent, copper would replace iron for roofing, cornices, piping, and other constructional purposes so as to raise the demand ten-fold if not more. While the stock of copper in the ground has not been estimated (miners and operators deeming the supply unlimited, just as a generation ago they thought iron inexhaustible), unless the quantity exceeds the indications, it clearly cannot long withstand the demands which would follow any great reduction in price. Unless it does so, the use of copper cannot seriously check the drain upon our iron resources.

Zinc, lead, silver, and other ores abound in our rocks, and their production is steadily increasing. Neither the original supplies nor the time they will last have been estimated; it is known only that one mine or district after another has been worked out, or the depths of the workings so increased as to raise the cost to a prohibitive figure and compel abandonment. The current and avoidable waste in mining and reducing these and copper ores is estimated by experts to average 30 per cent.

GOLD.

As iron and coal are the basis of industrial values, so gold is the basis of commercial values. Though there is enough gold-bearing mineral in the United States to give this country powerful influence in maintaining parity of gold, the aggregate supply has not been estimated—indeed, it cannot be, since nearly all rocks and earths and even the waters contain gold in various quantities, so that production is controlled wholly by the market price. Our production is large and steadily increasing; though the increase does not quite keep pace with that of such staples as corn, cotton, wheat, sugar, iron, coal, copper, silver, lead, and zinc. Doubtless the duration of the supply will depend solely upon commercial conditions. The waste in mining and reduction has always been large, ranging from 25 per cent to 50 per cent—indeed it is not uncommon for later miners to get their best returns from working the tailings left by their predecessors.

In view of the sobering facts presented, the thoughtful man is forced to realize, first, that our production and consumption of minerals are increasing much more rapidly than our population; and second, that our methods are so faulty and extravagant that the average waste is very great, and in coal almost as great as the amount consumed. The serious loss of life in the mines is a feature that can no longer be overlooked. Nor can we fail to realize that the most useful minerals will shortly become scarce and may soon reach prohibitive cost unless steps to lessen waste are taken in the interest of the future.

I have for many years been impressed with the steady depletion of our iron ore supply. It is staggering to learn that our once supposed ample supply of rich ores can hardly outlast the generation now appearing, leaving only the leaner ores for the later years of the century. It is my judgment, as a practical man accustomed to dealing with those material factors on which our national prosperity is based, that it is time to take thought for the morrow. I fully concur in the opinion of the president that the state of our resources raises one of the most serious issues now before the American people, and hope that this national meeting will lead to wise action. * * *

SAVING WASTE.

Let us begin with iron: We must in all possible ways lessen the demands upon it, for it is with iron ore we are least adequately provided. One of the chief uses of this metal is connected with transportation, mainly by rail. Moving 1,000 tons of heavy freight by rail requires an 80-ton locomotive and 25 20-ton steel cars (each of 40-ton capacity), or 580 tons of iron and steel, with an average of, say, 10 miles of double track (with 90-pound rails), or 317 tons additional; so that, including switches, frogs, fish-plates, spikes, and other incidentals, the carriage requires the use of an equal weight of metal. The same freight may be moved by water by means of 100 to 250 tons of metal, so that the substitution of water-carriage for rail-carriage would reduce the consumption of iron by three-fourths to seven-eighths in this department. At the same time the consumption of coal for motive power would be reduced 50 to 75 per cent, with a corresponding reduction in the coal required for smelting. No single step open to us today would do more to check the drain on iron and coal than the substitution of water-carriage for rail-carriage wherever practicable, and the careful adjustment of the one to the other throughout the country.

The next great use of iron is in construction, especially of buildings and bridges. Fortunately, the use of concrete, simple and reinforced, is already reducing the consumption of structural steel. The materials for cement and concrete abound in every part of the country; and while the art of making and using them are still in their infancy, the products promise to become superior to steel and stone in strength, durability, convenience, and economy of use. The cement industry is growing rapidly, largely in connection with the making of iron and steel, so that the substitution of the new material will not involve abandonment of plants or loss of invested capital.

A large current use of steel of the highest quality is for battleships, ordnance, projectiles, and small arms. Happily, there are signs of an awakening of the public conscience, and of the sense of national righteousness, whereby civilized nations must be led to adopt those moral standards which already regulate individual conduct; the world is soon to learn that war is not only too disgracefully inhuman, but too wasteful, to be tolerated, and this serious drain upon our iron ores will cease. * * *

Among the most abundant materials of the earth crust are silica, alumina, and carbon compounds, all with more or less affinity for iron; already the alloying of carbon with iron has revolutionized the industrial world, and of late the alloying of silica with iron (in "ferro-silicon," etc.) gives promise not only of yielding a superior metal, but of permitting reduction of siliceous ores hitherto unworkable, while alumina has been alloyed with iron in a useful way. It is not too much to hope that research into the ultimate constitution and relation of these commoner materials will yield both better and cheaper metals than any thus far produced, and that newly discovered alloys will help to relieve the pressure on our mines of iron, copper, zinc, silver, and lead.

SAVING IN USE OF COAL.

We now come to coal. How shall we save that? Current uses— or rather current wastes—offer suggestions: The most serious waste arises from imperfect combustion in furnace and firebox. The waste of 90 per cent and over of the potential energy of the fuel in power-production—which, however, we know not yet how to avoid—is appalling in itself, while the smoke and soot from the chimneys becloud and befoul cities, poison human lungs, and prepare the way for pneumonia (one of our worst modern scourges), and initiate all manner of additional wastes. We have already learned that internal-combustion engines and gas-producers double or triple the power per unit of coal, obviate the smoke nuisance and also permit the use of lignite, culm, slack, and inferior coals—in fact, so far as power-production by reciprocal engines is concerned, the days of steam seem to be numbered although the development of substitutes is still in its infancy. The consumption of coal in smelting is necessarily large; of late the loss is reduced by using the furnace gases for power, and by making by-products; yet the chief saving must lie in economy in the use of metals. Much of our coke-making is still extravagant; some ovens use the gases, and all should do so without delay—if necessary, under state regulation, since the people have some rights both in the preservation of their heritage and in maintaining the purity of the air they breathe.

Next to imperfect combustion, the chief waste of coal arises in mining. Now that the coal in the ground is recognized as part, and a great part, of the value of coal lands, self-interest impels the operator to take out all he can, and leads the miner to work close to floor and roof. Bad results may sometimes follow, as in the anthracite region, where the entire forest growth has been stripped and both land and streams ruined to timber the mines, and in those terrible accidents when in removing the pillars of coal the miners are buried. Coal mining cries out for expert knowledge whereby the full yield may be obtained without needless risk or loss; and for wise police regulation whereby life may be protected against ignorance and cupidity.

The most promising check on coal consumption is the substitution of other power. Naturalists tell us that coal is a reservoir of solar energy stored up in ages past, and that the same is partly true also of other chemically complex substances, including ores. The sun-motor still runs; its rays render the globe habitable, and may yet be made to produce power through solar engines, or may be concentrated in furnaces—as in the Portuguese

priest's heliophore at the St. Louis Exposition, with its temperature of 6,000 degrees Fahr., in which a cube of iron evaporated like a snowball in a Bessemer converter. The sun helps to raise the tides, which some day will be harnessed. * * * It is only within the past decade that electrical transmission has made water-power generally available for driving machinery, for smelting, and for moving trains, and has at the same time created a new market for copper; yet it is a safe forecast that this method of using solar energy (for such water is as the product of sun-heat) will soon affect the constantly increasing drain on our coal. And just as the woods and the ores and the mineral fuels have become sources of wealth and power within our memory, so will become the running waters within a few years!

No practical man can study our mineral supplies without seeing that they are melting away under our national growth at a geometrically increasing rate, and without realizing that unless the loss is checked his descendants must suffer; nor can he consider ways of preserving the supply without realizing the need of wider and deeper knowledge that we now possess. It was not resources alone that gave this country its prosperity, but inventive skill and industrial enterprise applied to its resources. Individually we have been both forehanded and foreminded; nationally we have been forehanded chiefly through the accident of discovery by John Smith and Walter Raleigh, but nationally we are not yet foreminded. So far as our mineral wealth is concerned, the need of the day is prudent foresight, coupled with ceaseless research in order that new minerals may be discovered, new alloys produced, new compounds of common substances made available, new power-producing devices developed. The most careful inventory of the family patrimony should be made. I plead for economy, that the next generation and the next may be saved from want—but especially I urge research into and mastery over nature, in order that two blades may be made to grow where one grew before, that the golden grain may be made to replace woody grass, that crude rocks may be made to yield fine metals.

DUTY OF THE HOUR.

In conclusion, Mr. President and governors of our states, it seems to me our duty is:

First, conservation of forests, for no forests, no long navigable rivers; no rivers, no cheap transportation.

Second, to systematize our water transportation, putting the whole work in the hands of the reclamation service, which has already proved itself highly capable by its admirable work. Cheap water transportation for heavy freights brings many advantages and means great saving of our ore supplies. Railroads require much steel, water does not.

Third, conservation of soil. More than a thousand millions of tons of our richest soil are swept into the sea every year, clogging the rivers on its way and filling our harbors. Less soil, less crops; less crops, less commerce; less wealth.

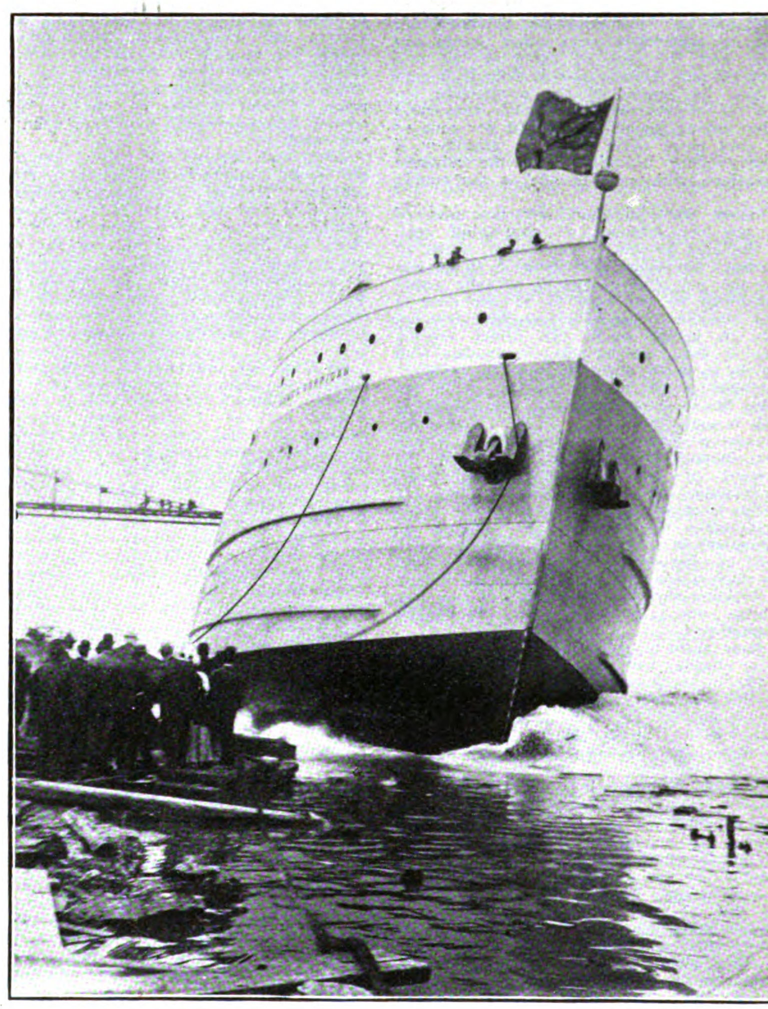
The way is not new: Washington and his compatriots pushed into the unknown in projecting a nation on new principles. Franklin grasped a hardly known principality through the Geneva Treaty, and Jefferson seized an unexplored half-continent despite protests of those whose knowledge was even less than his own; Fulton, Morse, Henry, Edison, and Bell came to stand as kings among men by pushing into the unknown. Today the time is ripe for a further advance; our president, with farsighted patriotism, has arisen to lead effort and action. He deserves, and I am sure will receive, your earnest support and that of all citizens who understand the importance of the problems involved.

The address of Mr. James J. Hill, of the Great Northern railway, was largely devoted to agriculture. There are two ways in which the productive power of the earth is lessened. First by erosion, the sweeping away of the fertile surface into streams; second, by exhaustion of wrong methods of cultivation, such as single cropping.

James W. Elwell & Co., ship brokers and steamship agents, Battery Park building, 21-24 State street, New York, announce that Howard E. Jones has become a member of the firm.

LAKE LAUNCHINGS.

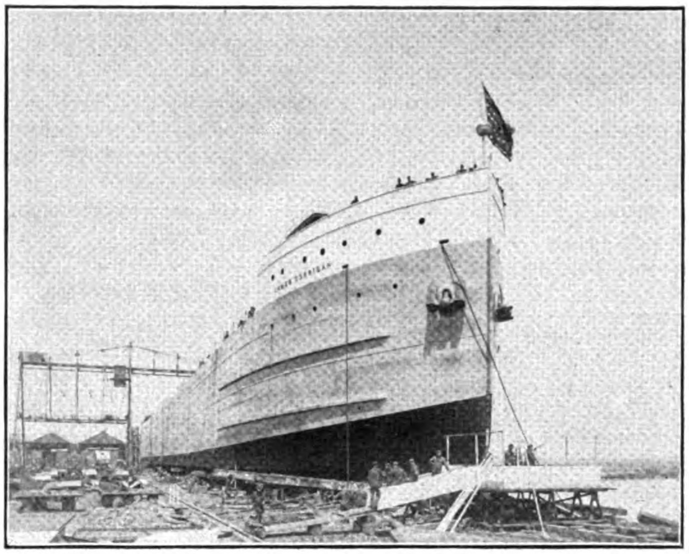
The bulk freighter James Corrigan was launched from the Ecorse yard of the Great Lakes Engineering Works on Saturday last and was christened by Miss Ruth Robinson, of Rochester. Hundreds saw the launching of the new steamer from the vantage point afforded by the sister ship Josiah G. Munro, which was lying at the head of the slip, and which whistled hoarsely as the Corrigan slid down the ways. As usual, weather favored the company, though the early part of the forenoon had been stormy. A glance at the accompanying picture will show how perfect was the launching, the steamer taking the water on an even keel. Instead of the usual form of banquet a light luncheon was served on board the special car Yolande before the return to Detroit. This was an especially agreeable feature, as the day was unusually warm and the launching party enjoyed the cool breezes from the river while dining. The customary speeches were in this case dispensed with.



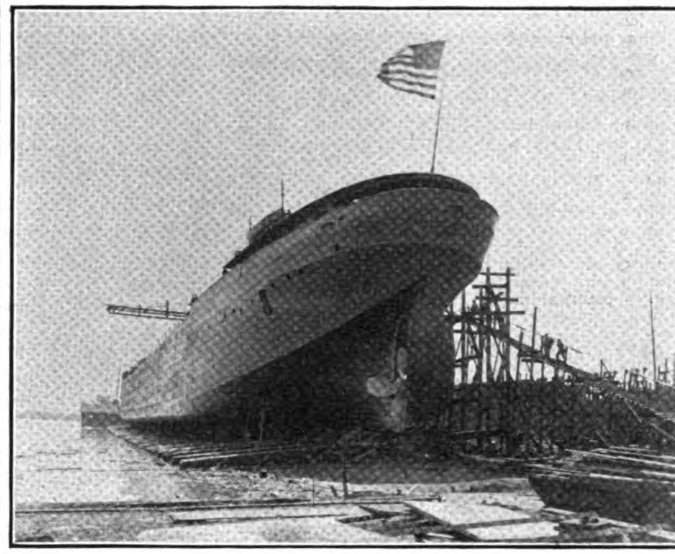
THE BULK FREIGHTER JAMES CORRIGAN TAKING THE WATER.

The Corrigan is building for the Frontier Steamship Co., of North Tonawanda, of which W. M. Mills is manager. The freighter is 550 ft. over all, 530 ft. keel, 56 ft. beam and 31 ft. deep, having 32 hatches spaced 12 ft. centers. Her engines are triple-expansion with cylinders 23, 37 and 63 in. diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 15 ft. by 11 ft. 6 in., fitted with forced draft and allowed 180 lbs. pressure.

Among those attending from Cleveland were James Corrigan, his son, J. W. Corrigan, Joseph Speddy, the Cleveland representative of Mr. Mills, and M. A. Bradley. The ship building company greatly appreciated the presence of Mr. Bradley as he had failed to attend the launching of the vessel named after him a few weeks previous. Others present were: From North Tonawanda, Eugene d'Kleist, mayor; Mr. and Mrs. Wm. M. Mills, Mr. and Mrs. L. S. DeGraff, Mr. and Mrs. Norman D. Fish, Mr. and Mrs. Everett Kelsey, Mr. and Mrs. J. H. Tillotson, Mrs. H. W. Clark; John Clark, J. P. Mackenzie, James S. Thompson; from Rochester, Mr. and Mrs. Lucius Robinson, Miss Ruth W. Robinson; from Buffalo, Capt. and Mrs. J. J. H. Brown, Mr. and Mrs. Harvey H. Brown, F. G. Rogers; Capt. C. E. Benham, from Cleveland; from Toledo, Mr. and Mrs. Wm. S.



BOW VIEW OF THE BULK FREIGHTER JAMES CORRIGAN.



STERN VIEW OF THE BULK FREIGHTER JAMES CORRIGAN.

Walbridge, S. C. Comstock; from Detroit, Miss Sue Hoyt, Mrs. Bates, Capt. J. W. Westcott, A. C. Pessano, John R. Russel and Henry W. Hoyt.

The Corrigan will be commanded by Capt. Alex Johnson, of Bay City, and E. H. Perry, of Port Huron, will be her chief engineer.

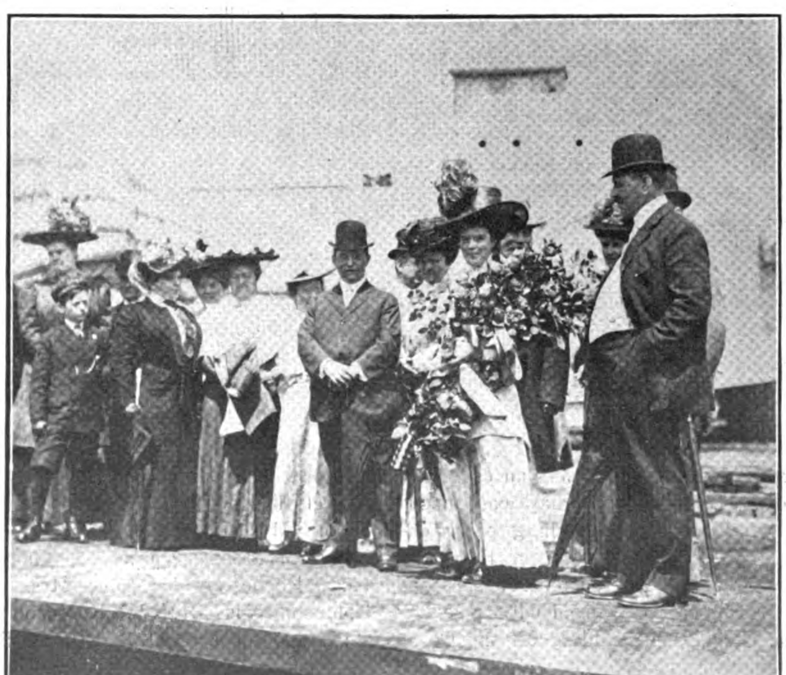
The sister ship, David B. Meacham, building for the Frontier Steamship Co., will be launched in about a month and will be brought out by Capt. Thomas Deringer, and her chief engineer will be Frank Trinkwalder, of Tonawanda.

The bulk freighter W. R. Woodford was launched from the Bay City yard of the American Ship Building Co. on Saturday last and was christened by Mrs. Guy M. Moulthrop, of Bay City. The steamer is named in honor of the vice president of the Pittsburg Coal Co. and is building for W. A. and A. H. Hawgood, of Cleveland.

The Woodford is 552 ft. over all, 532 ft. keel, 56 ft. beam and 31 ft. deep, having 32 hatches spaced 12 ft. centers. Her engines are triple-expansion with cylinders 23½, 38 and 63 in. diameters by 42-in. stroke, supplied with steam from two Scotch boilers, 14 ft. 6 in. by 11 ft. 6 in., equipped with Ellis & Eaves draft and allowed 180 lbs. pressure.

After the launching luncheon was served at the Bay City club. Those present were: W. R. Woodford, J. H. Sanford, H. A. and D. W. Kuhn, W. A. Terry, Mr. and Mrs. J. P. Yope, J. W. Walsh, of Pittsburg; W. A. Hawgood, John A. Donaldson, J. H. Woods, J. R. Hilton and Mr. and Mrs. D. C. Moon, of Cleveland; Frank Jeffrey, Neil Snow and E. A. Mancourt, of Detroit; H. T. Batchellor and J. T. Collins, of Saginaw.

Capt. W. L. Montgomery, of Port Huron, will bring the Woodford out.



THE CORRIGAN LAUNCHING PARTY.

LAKE SHIP YARDS.

The steamer building for J. J. Rardon, of Chicago, at the Lorain yard of the American Ship Building Co., will be named in honor of Price McKinney, of the firm of Corrigan, McKinney & Co. The new steamer will be launched on Saturday next. Capt. E. C. Van Patten, of Chicago, will sail her. The steamer J. F. Durston, building for the Wilkinson Transit Co., at the Superior yard, will also be launched on Saturday next. With the launching of these two steamers all vessels promised by the American Ship Building Co. for 1908 delivery will have been placed in the water.

The Buffalo Dry Dock Co. has a great deal of repair work under way and is employing nearly 1,500 men.

The steamer G. Watson French arrived in Cleveland on Monday with the first cargo of ore delivered at a Lake Erie port this season. The steamer went to the C. & P. dock where her cargo of 7,531 tons was worked out without trouble. The workmen on this dock have signed individual contracts with the dock managers for the next two years.

The Zenith Dredge Co. has started dredging in the Portage river where the steamer John Stanton stranded a week ago. It will be necessary to remove several shoals.

THE LOOKOUT.

During the month of April there were 114 vessels of all kinds built in the United States, with an aggregate tonnage of 63,176 tons gross. The ship building figures were recently made public by the bureau of navigation in its monthly report. In the list are many large steam vessels built of steel. Of such there are eight each of which has a tonnage of 4,500 and over. The largest is the Harry A. Berwind, of 6,634 tons, built at Ecorse, Mich.

The corner stone of the new $300,000 naval Y. M. C. A. building at Norfolk, Va., given by John D. Rockfeller, was laid May 14. Mr. Rockfeller, who was unable to be present in person, wrote as follows: "It is a privilege to be permitted to give expression in this form to the pride which all Americans feel in their navy, and to you who have consecrated lives to our country's defense."

The armored cruiser Maryland was the trophy winner in the recent record target practice at Magdalena Bay. The trophy is now in possession of the Illinois and directions have been sent to the commander-in-chief of the Atlantic fleet directing him to transfer it to the Maryland.

The British board of trade reports that employment for labor declined in March. The strike of engineers, shipwrights and joiners on the northeast coast seriously affected the market, and deprived a large number of other work people of employment who were not directly concerned in the dispute.

A short time ago a discussion took place aboard one of our large Atlantic liners as to whether or not a chambermaid on board a ship and in the employ of the steamship company was a seaman. If the question has not in the meantime been decided to their satisfaction the following may serve to throw some light upon the subject. Within the meaning of the law all persons employed in the navigation of a vessel, or upon a voyage, other than the master and mates, are deemed seamen, including cabin boys, cooks, stewards, chambermaids, carpenters, coopers, and pilots, surgeons, and boatswain, the clerk of a steamboat, all on board employed in the equipment or preservation of the vessel, so a female cook is a mariner, and foreigners employed on ships of the United States are mariners, and are not disqualified from becoming engineers and pilots in American steam passenger vessels. Persons shipped as sealers are mariners.

BOSTON MARINE NOTES.

Boston, May 20.—The coal barge Henry Endicott, built for the Cambridge Gas Light Co. at a cost of $40,000, was launched May 14 at Bath, Me. She was christened by Daniel G. Tyler, of Cambridge, Mass., a director of the company. The barge is rated A1 for 14 years and has a carrying capacity of 1,600 tons. She is 190.6 ft. in length and has a gross tonnage of 866.

There was another launching at the works of the Fore River Ship Building last Thursday. This time it was light vessel No. 90, the last of the four to be launched and completed for the lighthouse board, department of commerce and labor, United States government.

The famous schooner yacht Fleur de Lys, commanded by Capt. Thomas Bohlin sailed last week from Gloucester for a cruise up the Mediterranean. The Fleur de Lys is owned by Dr. Simpson, of Brooklyn, who was on board when the yacht rounded Eastern point, her bowsprit pointing toward Gibralter. At a convenient Mediterranean port, Dr. Simpson's guests, who have gone over by steamer, will be taken on board and the cruise continued at leisure.

The value of domestic exports from the port of Boston for the week ending May 8 fell below the million dollar mark for the first time this year, amounting to only $718.163, in comparison to $1,637,512 for the same period of last year. The value of imports that week was $1 235,623, as against $2,504,063 for the corresponding week a year ago.

"Eastern Yard, United States Navy, Rockport, Mass.," is the title by which the national harbor of refuge at Sandy bay is probably to be known, as may be seen from schedule No. 1,092 of the navy department.

The contract for building the superstructure for the Sandy bay breakwater has been awarded the Rockport Granite Co., and the Pigeon Hill Granite Co., with an appropriation of $200,000, from which a civil engineer's fees must be deducted. The companies have been notified and work will commence at once They have three years in which to finish the work. Two years ago, the Federal Contracting Co. secured the contract on the substructure, but have not completed their contract, being now busy dumping stone on the substructure. Under existing conditions, however, the successful companies can go ahead on their part of the job, and the end of the present year will see considerable progress made toward the completion of the breakwater.

COAST SHIP YARD NOTES.

The battleship Michigan will be launched on May 25 from the yard of the New York Ship Building Co., Camden, N. J., and will be christened by Miss Carol Barnes Newberry, daughter of the assistant secretary of the navy.

The collier Vestal, building at the Brooklyn navy yard, was launched on Tuesday.

The bid of the Newport News Ship Building & Dry Dock Co for the construction of a cable ship has been accepted by the war department. The vessel is to be 160 ft. long, 32 ft. beam and 16 ft. 4 in. deep, having a single screw engine. The bid was $194,000.

The Pusey & Jones Co., Wilmington, Del., were the lowest bidders for the construction of a mine laying ship at $161,794.

The three scout cruisers Chester, Salem and Birmingham, are being equipped with the Nicholson ship log. The order was placed through Barrett & Lawrence, eastern agents of the Nicholson Ship Log Co. One of these logs was recently installed on the Italian battleship Victorio Emanuele.

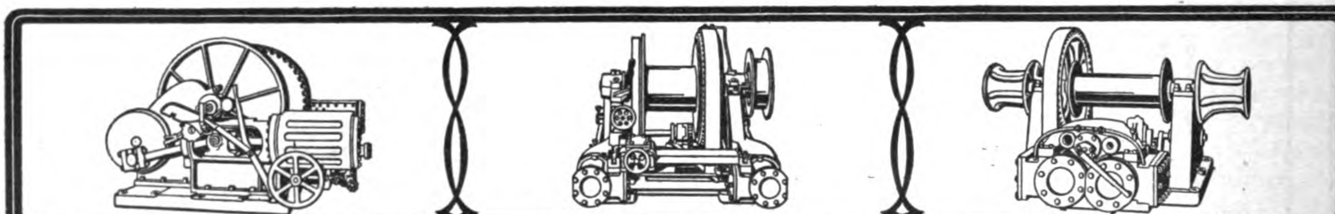
OBITUARY.

Capt. Patrick Griffin, one of the rare characters among vessel masters, died at Buffalo of heart failure last week while superintending repairs on his steamer Western Star, of which he was part owner. Capt. Griffin was well along in life and was probably known by every master on the lakes. He was a distinctive type. Martin Griffin, his son, an engineer, died suddenly at Hot Springs last winter.

Capt. Harvey L. Mills died at his home at Watertown, N. Y., last week of acute indigestion. For the past six years he was in the employ of the United States Transportation Co., sailing the steamer Hurlbut W. Smith last year. He was to have brought out the new steamer J. F. Durston which will be launched on Saturday next. Capt. Mills was 48 years of age and was one of the most successful masters on the lakes.

ADVERTISERS

The Star indicates alternate insertions, the Dagger once a month.



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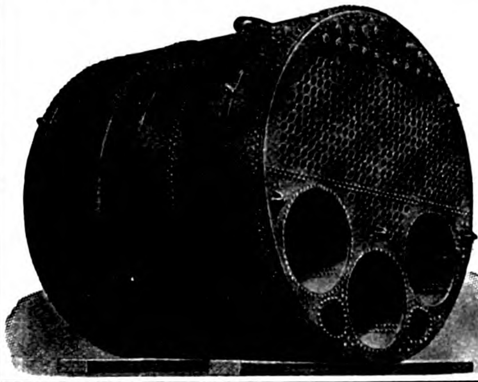

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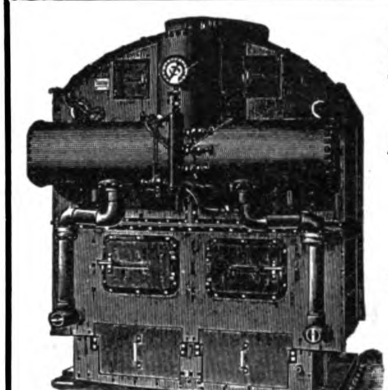

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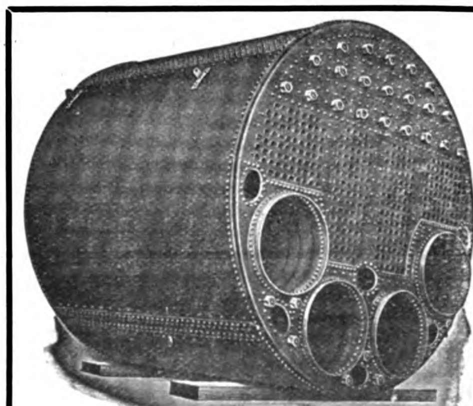

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SMALL STEAMER FOR SALE. Carrying capacity about 275 tons. Makes between ten and eleven miles per hour; length 117 ft. overall, beam 24 ft., depth 8 ft. Rebuilt last fall; engine 18 x 20; boilers in first class condition. Derrick forward, lifting capacity between seven and ten tons. Entire new outfit on boat last fall. Would make a good sand sucker or could be used for contracting. Address Box 129, the MARINE REVIEW, Cleveland, Ohio.

BOILER FOR SALE

FOR SALE. TWO SCOTCH MARINE Boilers built in 1895; diameter 16 ft., length 11 ft., with one set new tubes for boilers; corrugated furnaces renewed one year ago. Also one upright boiler, diameter 30 in., height 5½ ft., built in 1898. Further information furnished on application. Address U. S. Engineer Office, Galveston, Tex.

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NEAFIE & LEVY F & A COMpound 26"-50" x 30" with Surface Condenser and Pumps. Will alter to 22"-50" x 30" for high steam.

13½ K. W. Electric Lighting Set.

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Two Hawser Pullers (Capstans).

Two Providence Steam Windlasses.

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Worthington Duplex Air Pump & Jet Condenser 9" x 12" x 10".

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Two Scotch boilers 13½' x 12'.

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TUG "J. J. EVANS" FOR SALE, in first-class condition. Rebuilt, November, 1907, hull of oak, 45 feet keel length, 12 feet beam, 6 feet depth, 14 gross tons, high pressure Sutton engine, cylinder 14 x 14 inches, fire box boiler, 5 x 9½ feet, 100 lbs. steam. Can be seen at Two Rivers, Wis. Address Hamilton Mfg. Co., Two Rivers, Wis.

TREASURY DEPARTMENT,
Washington, D. C.,
May 15, 1908.

SEALED PROPOSALS are invited and will be received at the Division of Revenue-Cutter Service, Treasury Department, at 2 o'clock p. m., Saturday, June 6, 1908, for the purchase of the Revenue Cutter DALLAS.

The DALLAS is a single screw steamer of 370 tons displacement, with wooden hull; extreme length 140 feet, beam molded 21 feet 5 inches; draught 10 feet 9 inches; has one Scotch boiler 11 feet in diameter by 12 feet 6 inches in length, fitted with steam drum and three furnaces and operating 35 pounds pressure. The main engine is of the simple, condensing type with a cylinder 34½ inches diameter by 30 inches stroke, and is capable of 75 revolutions per minute; one surface condenser, with independent centrifugal circulator, with air and feed pumps of the attached type. The vessel is supplied with one general service or fire pump, a steam bilge ejector and one boiler injector.

The DALLAS is at Ogdensburg, N. Y., and can be seen at that place on application to Senior Captain H. D. Smith, U. S. R. C. S., who will furnish any additional information regarding it that may be desired and a list of articles of outfit that are to be sold with the vessel.

Each bid must be accompanied with a certified check in the sum of $500 made payable to the order of the Secretary of the Treasury. The Government reserves the right to reject any or all bids.

Proposals should be addressed to the Captain Commandant, U. S. Revenue-Cutter Service, Treasury Department, and indorsed on the envelope "Proposals for the Purchase of the Revenue Cutter DALLAS."

BEEKMAN WINTHROP.
Assistant Secretary.

ENGINES FOR SALE

TRIPLE EXPANSION MARINE engine for sale; 18 x 30 x 48 by 30-in. stroke, universal coupling, Joy gear, steam reverse engine with oil cylinder to reverse links. All in good shape and can be bought for $10,000 for quick sale. G. A. Graham, Iroquois Hotel, Toronto, Ont.

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